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ABSTRACT

With strong backing from the federal government, states and school districts are in the midst of a major push to put technology in the hands of America's teachers and students. Their efforts seek to equip schools and classrooms with computers, educational software, school-based computer networks, and links to both statewide and global information networks. This report examines several major issues that state leaders may want to consider as they develop programs to promote the use of technology in public schools. Information for the report was gleaned from in-depth interviews with state officials who have been involved in formulating and implementing legislation and policies related to educational technology. The following key issues for education technology planners are discussed: providing teacher training; securing ongoing funding; dealing with obsolescence; ensuring equity; measuring the effectiveness of education technology; recognizing the role of the teacher in a technologically equipped classroom; and finding funds for technology. The report describes education technology initiatives in six states: Arkansas, Florida, Iowa, North Carolina, Utah, and West Virginia. With computers and advanced telecommunications technology revolutionizing nearly every aspect of life and work, the question is no longer whether states and local school districts should incorporate technology into teaching and learning, but how they should do so. (SWC)

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NATIONAL GOVERNORS ASSOCIATION

State Strategies for Incorporating Technology into Education

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NATIONAL GOVERNORS' ASSOCIATION

Education Policy Studies Division

Center for Best Practices

State Strategies For Incorporating Technology into Education

by Mary Houghton

Since their initial meeting in 1908 to discuss interstate water problems, the Governors have worked through the National Governors' Association to deal collectively with issues of public policy and governance. The association's ongoing mission is to support the work of the Governors by providing a bipartisan forum to help shape and implement national policy and to solve state problems.

The members of the National Governors' Association are the Governors of the fifty states, the territories of American Samoa, Guam, and the Virgin Islands, and the commonwealths of the Northern Mariana Islands and Puerto Rico. The association has a nine-member Executive Committee and three standing committees—on Economic Development and Commerce, Human Resources, and Natural Resources. Through NGA's committees, the Governors examine and develop policy and address key state and national issues. Special task forces often are created to focus gubernatorial attention on federal legislation or on state-level issues.

The association works closely with the administration and Congress on state-federal policy issues through its offices in the Hall of the States in Washington, D.C. The association serves as a vehicle for sharing knowledge of innovative programs among the states and provides technical assistance and consultant services to Governors on a wide range of management and policy issues.

The Center for Best Practices is a vehicle for sharing knowledge about innovative state activities, exploring the impact of federal initiatives on state government, and providing technical assistance to states. The center works in a number of policy fields, including agriculture and rural development, economic development, education, energy and environment, health, social services, technology, trade, transportation, and workforce development.

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Executive Summary

With strong backing from the federal government, states and school districts are in the midst of a major push to put technology in the hands of America's teachers and students. Their efforts seek to equip schools and classrooms with computers, educational software, school-based computer networks, and links to both statewide and global information networks.

Most educators agree that the advent of computer and information technology in the classroom is an exciting, even revolutionary, development. Yet there is recognition that integrating technology into education systems and using it in ways that increase student learning and achievement are far more complex tasks than expected. States that have forged ahead to promote the use of education technology, including the six states profiled in this report, have learned much from their efforts to date. Their successes provide valuable models for others to follow, while their ongoing challenges suggest important lessons from which all states can learn.

This report examines several major issues that state leaders may want to consider as they develop programs to promote the use of technology in public schools. Information for the report was gleaned from in-depth interviews with state officials who have been involved in formulating and implementing legislation and policies related to education technology.

The report also draws on discussions at a Washington, D.C., meeting convened by the National Governors' Association (NGA) in December 1996. At the NGA meeting, representatives from more than a dozen states described their experiences and exchanged views on the most pressing problems that confront education technology planners.

The meeting did not seek to produce any conclusions about education technology planning. Its purpose was to enable planners from numerous states to learn from one another by sharing their experiences and views. Several key points emerged from the discussions. First, the participants agreed that no amount of technology in schools will make a difference unless teachers are adequately trained on how to use technology effectively as an instructional tool. Participants voiced the opinion that states and school districts must devote a sizable portion of their technology budgets—30 percent or more—to staff training.

Second, the participants agreed that funding for education technology must become a line item in state budgets. States with well-developed education technology efforts have found that it is not possible to integrate technology into education through a "one-time" supplemental appropriation. The costs for technology extend well beyond the initial costs of purchasing and installing hardware and software. Reliable, long-term funding is needed to maintain, repair, and upgrade the technology, as well as to keep teachers up to date on its use in the classroom. Technology creates significant ongoing expenses for education systems, so ongoing funding for technology must be available.

Finally, the participants acknowledged that technology is changing basic notions of

schools and education. With numerous forms of distance learning now available, the public education system is moving away from the need for students and teachers to assemble in school buildings for education to occur. This trend has far-reaching implications for the structure of state education budgets.

Examples of how leading-edge states have approached these three issues—the need for staff training, the challenge of meeting the ongoing costs of education technology, and the incorporation of distance learning and other technology-based options into current education structures and concepts—are presented throughout the six state profiles that comprise the majority of this report. The state profiles also document solutions to many other important issues, including how to deal with the rapid obsolescence rate of education technology, how to ensure equitable access to technology among all school children, how to determine and measure learning goals related to technology, how to balance state and local authority regarding the expenditure of technology funds, and how states can work with the private sector to advance education technology goals.

The report describes education technology initiatives in six states.

- Arkansas, where two private nonprofit companies established by the state are working to put computers in schools and build a statewide communications network for the public school system.
- Florida, where a recent, in-depth review of long-term education technology programs enabled the state to pinpoint weaknesses and initiate improvements.
- Iowa, where six overarching strategic targets are guiding a continually evolving education technology effort that features a nearly completed statewide fiber optic communications network, a $30 million state program to fund school technology purchases, and several initiatives to promote the effective use of technology in the classroom.
- North Carolina, where a state technology plan approved in 1995 has prompted the development of five-year technology plans by local school districts and the formulation of state technology competencies for both aspiring and practicing teachers.
- Utah, where a long-term commitment to education technology by the Governor and state legislature has resulted in programs to equip schools with hardware and software, maintain and upgrade school technology, and provide online instructional programs and other distance learning opportunities for students.
- West Virginia, where staff training and equipment maintenance have been key components of the state's successful, ten-year effort to install computer technology in all kindergarten through grade six classrooms.

With computers and advanced telecommunications technology revolutionizing nearly every aspect of life and work, the question is no longer whether states and local school districts should incorporate technology into teaching and learning, but how they should do so. Policymakers searching for answers to this question will find many practical and creative ideas in this report.

Introduction

Education systems are working feverishly to incorporate technology into teaching and learning. States and school districts are spending millions of dollars to put computers in schools and connect them to local and global networks. These efforts are being supported at the federal level. President Bill Clinton has called for all schools to be connected to the Internet by 2000, and the fiscal 1997 federal budget contains dramatic increases in funding for education technology.

Schools that have begun making extensive use of technology are excited by the results. Students are more engaged, motivated, and confident. Teachers are using technology to enliven and enrich the curriculum, enable students to learn at their own pace and according to their own learning styles, nurture teamwork and cooperation among students, and expose students to new learning experiences. Students are mastering the computer skills that they will be required to know and use in the workplaces of the twenty-first century.

Information technology is changing profoundly the American economy and workplace. The question is no longer whether states and local school districts should ensure that all public schools incorporate technology into teaching and learning, but how they should do so. What factors should a state consider when planning for education technology? What are the costs? What purposes should be served by education technology? How can states ensure that their investments in education technology produce the desired outcomes?

These questions are new ones for state education policymakers. Many state and local education planners have never put together a technology plan. Moreover, most planners were educated before computers were used widely in schools and colleges, so they have limited experience on which to draw. In addition, technology is constantly changing, requiring planners to continually rethink and revise their goals and approaches concerning the uses of technology in education. It is no wonder that many state technology planners are somewhat daunted by the task of incorporating technology into teaching and learning.

To assist states with their technology planning efforts, the National Governors' Association (NGA) began a project in fall 1996 to examine the experiences of six states that have made substantial progress in implementing education technology initiatives—Arkansas, Florida, Iowa, North Carolina, Utah, and West Virginia. NGA staff interviewed key policymakers in the six states to identify what approaches are being taken, what is working, where the toughest challenges lie, and what lessons have been learned.

In addition, NGA invited representatives from these six states, as well as policymakers from other states wanting to learn from them, to a meeting December 11–12, 1996, in Washington, D.C. Participants discussed their experiences with education technology planning and the issues confronting planners as they try to provide equitable, affordable, education-enhancing technologies for schools.

Drawing on the state interviews and the discussions at the NGA meeting, the major issues confronting education technology planners are explored in Chapter 2. The education technology efforts of the six study states are described in Chapter 3. The features that make each program successful or unique are highlighted together with the lessons learned by each state. Woven throughout the chapter are examples of the ways that the six states approached many of the issues identified in Chapter 2. It is hoped that these descriptions will prove instructive and inspiring to states that are ready to begin integrating technology into the education process.

Key Issues for Education Technology Planners

Through the discussions at the December 1996 meeting and the interviews with officials from the six study states, NGA staff sought to identify the key issues that state planners may want to consider when developing state education technology programs and initiatives. Everyone involved in education technology planning is struggling with the same issues, including the need to train teachers, secure ongoing funding, develop ways to deal with obsolescence, ensure equitable access to technology, measure the effectiveness of technology expenditures, and find innovative ways to finance technology efforts. Some of these issues are easier to solve than others, but all merit consideration as a state develops an effective technology program for schools.

Providing Teacher Training

Historically, state education technology efforts focused primarily on providing technology infrastructure and equipment to schools, such as communications lines, computers, and software. Funding for training teachers on how to make the best use of technology comprised only a small percentage of state technology budgets. Today, teacher training is receiving more attention. Participants at the NGA meeting agreed that teacher training must become a top priority in state and local technology planning. Expenditures for infrastructure and equipment may be wasted if teachers do not know how to make effective use of these new tools in the classroom. Several participants advocated spending up to 30 percent or more of technology dollars on teacher training to ensure that investments in equipment result in improved teaching and learning in schools.

One participant noted the significant resources that many corporations are devoting to technology training. Observing that many companies expect to increase the percentage of employee time spent on training, the participant asked, "What does that mean in terms of the industry of teaching? I think we need to really think of teacher training beyond a half-day workshop once a year and begin to view it as an integral part of the profession."

Promising Ideas

West Virginia has made teacher training a top priority, with approximately 30 percent of state and local funds spent under the state's main technology initiative devoted to ongoing technology training for teachers and administrators.

Adopted in 1995, North Carolina's state technology plan requires local school districts to devote between 20 percent and 30 percent of their total technology program expenditures to staff development and training. In addition, practicing teachers must obtain three to five credit hours in courses related to technology to be recertified, while new teachers will soon be required to pass a technology assessment to be licensed.

Securing Ongoing Funding

Currently, most states fund education technology initiatives through supplemental appropriations. Participants at the NGA meeting believed that this financing approach needs to change. Technology costs for schools go beyond one-time hardware and software expenditures. Additional, ongoing expenditures for maintenance and repair, teacher training, facilities modification, and telecommunications access must also be factored into the cost equation. Moreover, technology is constantly changing, so funding will always be needed for upgrades. Many meeting participants asserted that technology funding should be a line item in state budgets.

As one attendee noted, there is nothing more frustrating for a school administrator than to purchase several state-of-the-art computers but have no funds to pay for needed repairs of this equipment. Although it is customary for businesses to have onsite technical support staff for installing, maintaining, and repairing computers and other technology, this support capability frequently is overlooked or given short shrift in the education sector. The most sophisticated computer system in the world is of no value to teachers and students if it is broken.

Promising Ideas

In 1993 the Utah legislature established a line item in the state budget to fund school districts' costs for repairing, replacing, and upgrading hardware and software purchased with state funds.

West Virginia has made technology maintenance a top priority, providing regular funding for a maintenance and repair crew within each of the state's regional education systems.

Although educational technology is not yet a line item in the Iowa budget, the state's School Improvement Technology Program explicitly provides that schools may use state technology funds not only for technology acquisition, but also for installation and maintenance.

Dealing with Obsolescence

Stories abound of schools spending large sums on state-of-the-art computer technology, only to have the equipment become outdated and unusable for desired applications within just a few years. How should school districts address the high rate of computer obsolescence?

Promising Idea

Reversing a previous state policy, a 1996 Iowa law provides that schools may use state funds to lease rather than purchase technology equipment.

Several NGA meeting participants commented that it no longer makes sense for schools to purchase equipment. They suggested that state and local education agencies collaborate with the computer industry to develop alternatives to purchasing. Several individuals advocated having states and school districts negotiate leasing arrangements with vendors that allow for the regular updating of technology. States and school districts could also contract for maintenance and support services. Rural schools, in particular, could benefit from leasing arrangements. In addition, schools could work with the computer industry to develop platforms that can be upgraded.

New federal laws support the leasing of education technology. The 1994 reauthorization of the Elementary and Secondary Education Act allows states and school districts to use federal funds to pay both the principal and interest payments of lease-purchase arrangements. However, state and local laws often pose obstacles to leasing. For example, state and local bond regulations typically prohibit the use of bond revenues for leasing. States and school districts interested in pursuing leasing need to investigate applicable bond regulations to identify barriers to leasing and seek any necessary regulatory changes.

NGA meeting participants generally agreed that schools should not accept donations of obsolete equipment from businesses. The equipment not only will be unable to perform many desired applications, but it also is likely to require significant maintenance. Nevertheless, a meeting attendee from Florida reported that her state has had some success in upgrading donated equipment and distributing it to schools. She noted that the state department

of education continues to be inundated with requests from schools for the used equipment.

Ensuring Equity

Technology can promote educational equity among American schoolchildren by equalizing access to information and high-quality learning experiences. However, this requires that all students and educators have access to technology. NGA meeting participants discussed the need to ensure that technology works to narrow, not widen, the gap between America's "haves" and "have-nots."

Ideally, technology should be available in classrooms, not just in computer labs. Moreover, equipment must be up to date and in good working order for access to have meaning. For educators, access may also mean the availability of technology at home—perhaps in the form of portable equipment—because home is where most preparation for classes occurs.

Meeting attendees agreed that equity and access are related to the way technology is used in the classroom. Students who attend schools where technology is used ineffectively will leave school poorly prepared for employment or higher education. Students who attend these schools and also have no access to technology in their homes will be at an extraordinary disadvantage when they graduate from high school.

"We can't define equity solely in terms of the number of computers per student," said Charles Blaschke, president of Education Turnkey Systems, Inc., a firm in Arlington, Virginia. He noted that computers must also be used effectively in the classroom. "The quality of instruction has to be there, the training has to be there, and the computers have to be up to date." Blaschke suggested that in assessing equity, states consider not only the numbers of computers in schools but also qualitative measures.

Several participants indicated that access to technology can be increased by making technology available to the public in a variety of settings, including schools, libraries, community centers, and churches. "If access to information technology is critical to success in our society, then all of these institutions have to step forward and help provide some of that access," said a meeting attendee.

Another participant suggested that school districts work with community colleges to develop and implement neighborhood technology literacy programs. "There is no single right answer to ensuring equity, but one of the first approaches is to promote community partnerships."

Other attendees stressed the importance of collaboration among schools in building telecommunications networks and ensuring access for all students. "If schools don't collaborate, they have a tendency to isolate themselves. Then they don't get the access they need and fall behind. Without collaboration, we are all destined to trying to solve the same problem in isolation," said a participant.

Meeting attendees agreed that state governments can play an important role in ensuring access to technology and promoting its effective use in the classroom. States can enact universal service laws, hold grant competitions to target limited resources to technology-poor schools, and require schools receiving technology funds to explain how they will use the equipment to promote the achievement of learning standards. With gubernatorial leadership, states can also help local communities mobilize support from all sectors to equip schools with technology and associated infrastructure.

Rich Gross, lead consultant to Iowa Star Schools, believes that families, civic organizations, businesses, and industry must all be involved in community technology planning to ensure equal access to technology. "Some of the answers may [lie with] the community cable system providing some kind of basic Internet or intranet services for certain families that could not [otherwise get them], with computer equipment that could be checked out," Gross suggested. "The first step toward ensuring equity is to involve everyone in the community in technology planning."

Measuring the Effectiveness of Education Technology

NGA meeting participants noted that state legislators and the public want evidence that expenditures on technology are producing improvements in education. They also

Promising Idea

West Virginia schools that receive state funding must provide access to technology during nonschool hours. "That means opening the doors up at night, on the weekends, and during the summer. It also means having checkout programs for laptop computers," said a representative from the West Virginia Department of Education.

observed that legislators and the public typically evaluate the success of an education reform based on whether it has helped raise students' standardized test scores, often believing that money was wasted if test scores did not increase.

These observations raise questions about how best to measure the effectiveness of education technology. Is raising standardized test scores the only purpose of putting technology in schools? Do test scores fully reflect the education benefits offered by technology? Participants at the NGA meeting agreed that the answer to both of these questions is no. "We are obsessed as a nation about whether American students' test scores are going up," said one participant, "but technology is valuable for reasons other than improved test scores."

One of the problems with using test scores to measure the effectiveness of technology is the number of variables that affect these scores and limit the ability to make a one-to-one correlation. For example, test scores from a school that experienced a significant turnover in student enrollment or lost several key teachers would provide an unclear picture of the impact of technology on student learning.

Some participants suggested that instead of looking at test scores as the only indicator of technology's success, states should look at certain "quality indicators." For example, because studies have shown that students learn better when information is presented in ways that are suited to their individual learning styles, it makes sense to evaluate the effectiveness of technology based on its ability to present information in ways that accommodate various learning styles. Although the goal of education reform, including the integration of technology into education, is improved student learning, a realistic evaluation of the impact of technology must consider technology in the context of other factors that influence student learning.

Participants discussed the fact that technology is spurring new ways of thinking about student achievement. The ability to research, analyze, apply information, communicate, and engage in collaborative writing are skills that can be enhanced through the use of technology. However, these "knowledge worker skills" are not measured directly by current standardized tests. Several meeting participants suggested a need for new goals, content standards, and assessments that cover these technology-related skills.

One meeting attendee cited an example of a school district in her state that has done a good job of formally defining its curricular goals related to technology. The district's goal was that by 1996, all students would graduate from district high schools with information management skills, including skills related to word processing, database management, spreadsheets, and network navigation. "It's the first thing I've ever seen that talks about technology and says, 'This is what we're going to do and this is how we are going to accomplish it.' It doesn't talk about test scores at all," she said. Participants shared a hope that legislators and Governors would view the purpose of technology as imparting these kinds of skills, rather than as raising test scores.

Recognizing the Role of the Teacher in a Technologically Equipped Classroom

Today's telecommunications technology is creating exciting new opportunities for distance learning. For example, through two-way

Promising Idea

North Carolina's kindergarten through eighth-grade curriculum includes detailed goals, objectives, and competencies related to technology use. Beginning in 2001, these students must have passed a technology assessment measuring their mastery of these technology skills to graduate from high school.

videoconferencing, electronic mail (e-mail), and other forms of electronic communication, people living in rural communities can now take courses at universities or conduct research that previously would have been possible only by traveling to a distant city. Moreover, technology can make a class lecture, a professor's help, or the resources of a university library available twenty-four hours a day. "Technology makes the school virtual," said a meeting participant. "It pushes us beyond bricks-and-mortar thinking about what a school is."

Inside classrooms, telecommunications technology is exposing students to rich sources of information and exciting new educational experiences. For example, students can conduct research on the Internet, listen to an online lecture, or participate in an interactive workshop with an expert in another city. No longer is the teacher the only source of knowledge and wisdom; with telecommunications technology, students can find the information they are seeking outside the classroom.

These new developments raise questions about the role of the teacher in the technologically equipped classroom. Will the increasing use of technology in schools diminish teachers' usefulness and power? Should teachers be concerned that they might be replaced by technology? The consensus among meeting participants was that technology may change the role of the teacher—from the sole dispenser of knowledge to the guide who helps students use technology to more fully investigate a given topic—but it will not replace the teacher. Teacher guidance and supervision enable students to realize the greatest benefits from technology.

Participants agreed that technology is a tool that teachers can use to make classroom instruction more stimulating, engaging, and effective. Teachers who already are using technology report that it helps them work more effectively and efficiently with students who have different learning styles or special needs. These teachers also have found that many students who seldom participate in class discussions are more engaged when interacting with others online. In addition, studies indicate that students who have experienced computer-based instruction are more confident and motivated, particularly when the technology enables learners to control the pace and difficulty of lessons. Finally, contrary to fears that technology isolates students from one another and from their teachers, technology is encouraging cooperative learning and increasing teacher-student interactions. Technology expands greatly a teacher's ability to help all students achieve at higher levels.

Nevertheless, NGA meeting participants noted that some educators feel threatened by the nationwide push to put technology in schools. A few state education agency representatives blamed themselves for these fears. "In any other endeavor, better and newer tools are seen as a benefit to the profession," said one state official. "I think we've done a poorer job in education in terms of defining the power of the tool in the hands of the good user, which is the teacher. Somehow we've tended to say the tool replaces the person who yields the tool. It doesn't. I don't think we've done a good job of making that case."

Another participant explained that in the many years he has worked with institutions that make extensive use of distance learning and technology, "We have never, ever replaced a teacher. The reason is that as we've implemented these programs, the student audience has gotten larger." Technology, he said, leads to growth in the community of learners while encouraging lifelong learning.

Finally, Jodie Butler, education advisor to Iowa Governor Terry E. Branstad, pointed out that although the state teachers' union initially was concerned that the Iowa Communications Network—a statewide fiber optics network designed to improve education—would lessen the need for teachers, the union now wholeheartedly supports the technology. "As teachers began to see how the network was really going to open up the walls of schools and not reduce jobs for teachers, they became full partners in it."

Promising Idea

To foster enthusiasm and effective technology use among teachers, the Iowa Showcase program awards $1,000 stipends to teachers who discover new ways to use technology to provide exciting, high-quality learning experiences for students. Winning ideas are published so that other teachers may learn from them.

Participants agreed on the need to educate teachers better about how technology can make their jobs easier. Ongoing professional development is critical to achieving this goal.

Finding Funds for Technology

One of the most formidable challenges facing education technology planners is securing funding in an era of increasingly limited state and local budgets. Meeting attendees discussed a number of options for financing education technology. Participants pointed to the potentially large amount of money that could be freed up by increasing efficiency within school systems, and they noted that technology itself can produce efficiencies.

"The question of whether putting money into technology means taking it away from other important areas, such as building new schools or repairing leaky roofs, presumes that schools are now run at maximum efficiency," said Julia Stapleton, educational technology coordinator for the New Jersey Department of Education. "In my state, we've challenged that assertion. Schools can get one heck of a lot more efficient in their operations and that's where a lot of the dollars for technology will come from." Stapleton said that the department increased efficiency by penalizing districts that had high per-pupil administrative costs and rewarded those that produced good academic results and had low per-pupil administrative costs. "When you have too many central office administrators, you are wasting money that you could be spending on technology and instruction."

Several participants asserted that the cost-effectiveness of state and local staff development expenditures could be increased greatly, perhaps achieving savings that could be applied to technology needs. "If we look at the way professional development is done today, we have to conclude that there is an awful lot of waste. Teachers are taking courses or seminars that have very little to do with increasing the achievement levels of their students," said one participant. Another participant noted that, faced with the myriad of professional development offerings for educators, "maybe we're not doing a good enough job of saying, 'that [particular course or workshop] doesn't help or doesn't work.' "

Still another participant observed that technology can reduce the cost of many staff development programs. Specifically, if teachers took staff development courses through distance learning at their own convenience instead of taking two or three days off from school to attend courses, schools would not have to spend money to hire substitute teachers. Currently, expenditures for substitute teachers comprise a large percentage of professional development budgets. In addition, administrative costs can be reduced significantly by conducting meetings through teleconferencing rather than having numerous staff travel to meeting sites.

Promising Ideas

In Iowa educational facilities and other government entities are saving money by using the state's fiber optic communications network to conduct meetings and provide distance learning courses, including training and professional development sessions for educators.

Arkansas has achieved substantial cost savings by creating two private nonprofit corporations to equip schools with computers and build an education communications network. Although both entities receive state funds, their freedom from bureaucratic procedures enables them to operate more efficiently than a state agency.

Education Technology Initiatives in Six States

This chapter profiles education technology efforts in six states. However, it should not be inferred from the descriptions of technology initiatives that all of these states have developed a long-term, comprehensive plan for installing and using technology in schools. Most state technology "plans" consist of a wide variety of initiatives and programs, some of which have been operating for years, others of which are relatively new, and still others of which are still in the conceptual stage. The impetus for a state's education technology efforts may be a piece of legislation, a grant from a private foundation, a state agency initiative, or a private-public partnership. Most often, a state's work in education technology reflects several programs and initiatives.

Interviews with state officials by NGA staff revealed that state technology planning tends to be an evolving endeavor, rather than a one-time activity. For example, Iowa began developing its statewide fiber optic communications network in 1989, decided on a governing structure for the network in the mid-1990s, and now is working to fund additional hookups to meet the rising demand for network-delivered services. The state has undertaken numerous other education technology initiatives as advances in technology have continued to expand application potential.

The relatively sporadic nature of technology planning can be attributed to the unprecedented speed with which new technologies are being created and refined. In each of the study states, it was evident that no matter how carefully officials planned for education technology, at various times they all found their plans outstripped by advances in computer and telecommunications technology. Recognizing that this is an inherent part of technology planning, most of the states have tried to anticipate and plan for growth, change, and obsolescence as they proceed with their technology efforts.

The following accounts of state education technology efforts are not comprehensive. Rather than covering every technology initiative in each state, the descriptions focus on the features that make each program unique or that represent a particularly effective or innovative way of handling common planning or implementation problems. Together the descriptions provide a wealth of ideas for states that are beginning to embark on the exciting but complex work of integrating technology into education.

Arkansas: Progress Through Public-Private Partnerships

Arkansas has pursued its education technology goals through a unique approach that combines the strength of public funding with the flexibility of private enterprise. By setting up two nonprofit companies—one to put computers in schools and the other to connect

schools to a network—the state has achieved significant cost savings while sidestepping the bureaucratic hurdles that can sometimes slow down a large government project.

Putting Computers in Schools

The first of these two companies was created in 1983. Called the Instructional Microcomputer Project for Arkansas Classrooms (IMPAC), the company receives appropriations from the state legislature to install computer labs and instructional software in public schools. At each school it serves, IMPAC designs the lab and installs twenty-six computers; trains teachers and a lab manager; supplies software for basic skills instruction in reading, language arts, and mathematics for kindergarten through grade eight; and provides ongoing maintenance and repairs for the installed equipment. The school supplies the room and the tables to hold the computers and hires the lab manager and pays his or her salary. An annual appropriation of $2.2 million enables IMPAC to provide services to about forty schools per year.

According to Arkansas State Senator David Malone, IMPAC was created primarily to ensure that computers and software installed in Arkansas schools would be of consistent, high quality. In 1983 legislators were responding to what they viewed as a chaotic situation in which schools were receiving donations of obsolete equipment, teachers were confused about which software to use, and districts lacked guidance on how to put technology in schools. "We set up IMPAC to try to bring order out of that chaos," Malone said.

IMPAC's work is quite different from that of a state agency because the company also offers its services for a fee. Sales of hardware, software, installation, maintenance, and planning services to schools comprise about 33 percent of its operating budget. Many more Arkansas schools today have computer labs and instructional software than they otherwise would have if IMPAC activities were funded solely through state appropriations.

Why would a school pay to have a computer lab installed if it could get a state-funded one for free through IMPAC? IMPAC selects, based on an application process, only one school per district to receive its state-funded services, so most Arkansas schools have to pay for their own labs. Moreover, there are certain advantages to contracting with IMPAC to do the work rather than turning to another vendor. IMPAC provides its instructional software free to schools that pay for a computer lab. Its computers cost less than equivalent retail equipment. Its products and services, including room designs, computer equipment, software, training, and maintenance, are priced well and are liked by teachers and administrators throughout Arkansas.

IMPAC Executive Director Cecil McDermott explained that once a state-funded IMPAC computer lab is up and running in one school, it is not uncommon for district officials to decide to contract with IMPAC to install labs in the other district schools. "They like the way the one project is working and they say, 'Hey, I want it in my other schools.'"

McDermott also explained why IMPAC is able to provide equipment at such a good price. "We go out to bid on our computers, so we get a really good price on them. We pass that savings on to the schools that purchase through us."

The software provided to schools was developed jointly by IMPAC and Ideal Learning and is tied to the state curriculum. IMPAC's license with Ideal Learning enables IMPAC to put the software in Arkansas schools at no extra charge beyond the initial software development costs.

During IMPAC's Phase I period between 1983 and 1992, the company implemented 560 projects in 267 of the state's 311 school districts. Each Phase I project costs about $35,000. Phase II activities began in July 1992 and are aimed at upgrading equipment and software installed during Phase I and installing new labs in the few districts not served during Phase I. The average cost of each Phase II project is $50,000. By the end of the 1996–97 school year, IMPAC will have implemented 207 state-sponsored Phase II projects and

numerous district-sponsored projects. Since its inception, IMPAC has purchased more than 24,000 computers for schools, with the company's volume-purchasing practices resulting in a 17 percent savings on equipment costs, or $3,266,000 for the state and $2,707,000 for school districts.

IMPAC leaders believe that Arkansas' success in putting computers in schools results from the effort being carried out by a private nonprofit organization rather than a state agency. "It's much more efficient," said McDermott. IMPAC used to be run by the state department of education. "By the time we got through the department of finance and administration bidding process, we were way past our schedule for putting our projects in schools. The steps in the agency's process made sense, but the timeline was too long for efficient implementation. So the legislature allowed us to become a nonprofit agency so we could do our own bidding. Although we still follow a very stringent bidding process, we no longer have to wait to have our equipment approved through the department of finance and administration," he said.

A 1996 survey of Arkansas school superintendents conducted by IMPAC indicated that they are very pleased with IMPAC's services. With 210 of the state's 311 superintendents responding, 96 percent strongly agreed that IMPAC's services have been of significant value to students and teachers in their districts. Moreover, 92 percent strongly agreed that IMPAC's staff development and supervision activities have been very effective in their districts, and 82 percent strongly agreed that IMPAC's lower cost and educational effectiveness continue to be validated in their districts. Finally, 96 percent of the responding superintendents said that they considered it a high priority for IMPAC to continue to provide school districts with an option to secure a networked, interactive, computer-based project with high-quality courseware correlated to Arkansas curriculum standards.

Networking the Education System

A second private nonprofit company, the Arkansas Public School Computer Network (APSCN), has experienced operating efficiencies similar to those of IMPAC. APSCN was established by the state legislature in 1992 and charged with networking all sites in the elementary and secondary education system by June 1998 to improve administrative efficiency. The legislature also authorized a $25 million loan from the teacher retirement system to the state department of education to fund APSCN's networking activities. In addition, for the 1995–97 biennium, APSCN received $10 million in general revenue funding to cover recurring expenses, such as salaries, maintenance, and monthly line charges. Unlike IMPAC, APSCN does not earn fees for its services.

APSCN Director Bob Friedman discussed the benefits of having a private nonprofit company develop the state education system's electronic network. "We are able to be much more competitive with the private marketplace, so we are able to attract and maintain good people. Also, because we have certain personnel flexibility, we can make more rapid adjustments in our personnel needs than if we had to operate through state government." Friedman noted that the state budget process requires state agencies to plan three years ahead for personnel needs. "Once you get that budget you can't deviate." By contrast, he said, APSCN "must live within its budget, but we are able to make changes in our staffing based on needs."

APSCN also has more flexibility than a state agency in adjusting to the technology marketplace, Friedman said. "Oftentimes state governments set up procedures in such a way that you really can't take full advantage of the changes in technology, either in terms of cost or changes in equipment. We think we are able to get done what we've gotten done because we [operate] outside the typical state government procedures."

Friedman also discussed the advantages of a statewide approach, rather than a district-by-

district approach, to connecting schools to a telecommunications network. By aggregating demand, he said, APSCN can reduce the cost of equipment to each school. Moreover, APSCN has more leverage with the telephone companies because it represents all schools, said Friedman. That leverage proved essential during long negotiations with twenty-nine different telephone companies that took place before APSCN could begin installing wires and cables.

APSCN's statewide approach also promotes equity among schools because the same equipment and services are offered to all schools. "We don't face a situation like other states do where the districts go out and they all make their own individual arrangements, with the result that some districts have T-1 lines going to schools and others have dial-up access. We have a broad, level playing base, so we can be more equitable for all of our schools," said Friedman.

As of March 1997, APSCN had connected the state department of education, the state's 15 educational cooperatives, all 311 of the state's school district offices, and 885 of the state's 1,100 public school sites. By June 1998, the company is scheduled to have all remaining school sites connected to the network.

In addition, APSCN has housed an administrative service center in each of the state's fifteen educational cooperatives to provide school districts with access to an administrative software package. The service centers consist of a server, an administrative software package licensed by APSCN, and a staff member who works with the districts on implementing electronic recordkeeping and reporting. By June 1997, roughly two thirds of district office staff will have completed training on using the new system. The remaining districts will be trained during the 1997–98 school year. Effective July 1998, a new state reporting system based on the APSCN network and software will be implemented. A year later, state requirements for electronic student records transfer will become effective.

Arkansas education leaders are counting on the system to provide more accurate, timely data for state government. In addition, the system will give school and district administrators more efficient tools for conducting daily operations while reducing their reporting burden to the state department of education. By eliminating duplication, the new electronic reporting system is expected to reduce considerably the number of reports that school districts must submit to the state each year. Once completed, the new system will be used by all Arkansas schools and school districts for tasks related to financial accounting, personnel, fixed assets, and warehousing, as well as for all student records functions, including report cards, transcripts, daily attendance, class attendance, discipline, scheduling, and medical records.

Applying Technology to Instruction

Although the network originally was intended primarily for administrative purposes, it is also proving valuable for instructional access applications. As APSCN Director Bob Friedman explained, the same 56 kilobit dedicated lines that connect each school to the wide area network can also be used by teachers for Internet access or e-mail. As a result, Arkansas teachers and students have begun using the system to access the University of Arkansas library, communicate with students in other countries, and visit educational sites on the World Wide Web.

APSCN hopes to encourage the development of online courses. For example, Friedman envisions students in a small rural high school with limited course offerings using e-mail and web sites to take an advanced-level course taught by a teacher at a distant high school. Such applications are particularly valuable in predominantly rural states such as Arkansas. "Two thirds of our school districts are small districts of less than 1,000 students, so they can't always afford to offer the totally enriched, advanced curriculum. What we're looking at is a way to leverage resources and bring together schools, teachers, and students," said Friedman. He added that instruction based on e-mail and web site technology would be affordable

even for small schools. "It's not video-based learning where you have the extra dimension of being able to see the talking head, but it's a lot less costly. A district can get into doing this by having several multimedia computers in a media center and using the bandwidth that they already have."

To promote greater use of the network by teachers, APSCN sponsors the Arkansas Internet Master Training Program. The program teaches people how to teach others to use the Arkansas network as an instructional tool in the classroom. Participants in the master training program are designated by their school and must be willing to become onsite trainers at their school.

Although APSCN will complete its original mission when all elementary and secondary education sites in the state are connected in June 1998, Director Bob Friedman said that the organization's job will never be finished. "We know that there is constant growth in the number of schools, so in a sense you are never finished connecting," he said. In addition, schools that already are connected are now requesting more bandwidth, suggesting that APSCN will be busy upgrading the network for many years.

Praising the Planning Process

Arkansas State Senator David Malone noted that although Arkansas started later than other states in developing its telecommunications network, the state's public school system has quickly become one of the most well connected in the nation. He attributed the state's rapid progress to a long, careful planning phase during which Arkansas studied how other states created an effective network. "We started behind and spent much of our time in the planning process, learning a lot from other states about what they've done. We've come from way behind to a great deal of connectivity."

IMPAC Executive Director Cecil McDermott said that an equally careful planning process will characterize future education technology initiatives. "We are in a position not to have made major, big-time mistakes. We have a lot of players, we have done a lot of thinking, we've seen a lot of things in other states, and we've done some things. But really the one word that would summarize where we are now is 'synergy.'" This synergy will no doubt prove invaluable as Arkansas continues to build on its successes.

Florida: A Midcourse Study Provides Direction for the Future

Florida has promoted the use of technology in public schools for many years. State initiatives in recent years include:

- appropriating $230 million since 1993 to enable schools to purchase equipment and provide staff training;
- providing funding and guidelines for the retrofitting of hundreds of school buildings;
- constructing the Florida Information Resource Network (FIRN), a telecommunications network available to all schools, libraries, and postsecondary institutions;
- securing state contracts for instructional courseware at discounted prices;
- providing school districts with video-based instructional programs;
- working with instructional technology providers to produce custom products for use in Florida schools;
- establishing regional instructional technology centers to encourage technology planning and provide training for teachers and administrators;
- cosponsoring with other professional organizations an annual Florida Educational Technology Conference to facilitate the application of technology at all levels of education;
- creating the Florida Distance Learning Network, a nonprofit organization to promote distance learning initiatives; and
- establishing model technology schools in five districts across the state.

Jacqueline Mueller, program director for instructional technology for the office of

educational technology within the Florida Department of Education, credits strong, consistent support from Florida Governor Lawton Chiles and the current and past state commissioners of education for much of the state's progress. "When upper leadership is supportive, it makes a big difference," said Mueller.

Progress Assessment

In 1993 state leaders decided that an objective study was needed to document all of the state's technology initiatives, assess what had been accomplished, and provide direction for future efforts. The Florida Department of Education contracted with the Center for Educational Leadership and Technology (CELT), a research firm in Marlborough, Massachusetts, to conduct the analysis.

"We had put a lot of money into technology. We were interested in knowing whether the people who were closest to the classroom were even aware of these initiatives, whether they were taking advantage of them, and how we should prioritize our efforts in the future," explained Mueller. "We felt we had to get a handle on all the technology initiatives that were going on," agreed Peter Lenkway, administrator of the office of educational technology.

CELT studied Florida's state-sponsored education technology initiatives. The firm interviewed key state staff, reviewed government documents, visited school districts, conducted focus group interviews, and conducted a survey of all Florida schools. Its final report, *A Study of Florida's Statewide Technology Initiatives*, describes the status and effectiveness of existing initiatives, examines gaps among programs, identifies barriers to the effective use of technology by teachers and administrators, and makes numerous recommendations for strengthening the state's technology efforts.

The 1994 report concluded that although much has been accomplished by the state and local districts in increasing the use of technology in schools, many needs still remain. Key findings and recommendations included the following.

- *Instructional Support.* The majority of computers and other equipment in schools is outdated, and teachers cannot take advantage of many current teaching and learning applications. It is likely that Florida schools will need to acquire more than 2 million additional computers by 2000 to support access to learning resources. The state should provide guidelines, specifications, and funding to support the acquisition of courseware and hardware.
- *Training Programs.* Training is the most obvious need in the schools and must be the highest priority for the office of educational technology. The state should strive not only to increase training opportunities for the field, but also to diversify training programs and delivery systems.
- *Access.* The office of educational technology should continue to support statewide networking and distance learning to increase access for all schools. By 2000, all Florida schools should have access to distributed instructional resources.
- *Infrastructure.* Continued growth and refinement of the statewide technology infrastructure will be required to facilitate equity of access to teaching and learning resources across the state. The retrofitting of school buildings will be critical to providing classrooms with access to many existing resources and maximizing the return on investment in these resources. The Florida Information Resource Network should be upgraded as faster transport mechanisms become available. In addition, the office of educational technology must encourage local leaders to make classroom access to FIRN a high priority.
- *Leadership.* State leadership in education technology is strong and must be maintained. An important leadership function of the office of educational technology will be to provide current information to local schools about education technology resources as well as training to support the appropriate use of these resources. The office must also continue its role as an

Additional Findings of the 1994 Center for Educational Leadership and Technology Study in Florida

- Ninety-three percent of Florida schools have televisions and video cassette recorders (VCRs) available to all classrooms, 77 percent are wired to receive cable television, 56 percent have video production studios, and 20 percent are equipped with multimedia workstations. However, 78 percent of schools said that they do not have the capability to take advantage of distance learning courses.
- Word processing and graphics programs have changed considerably reading, writing, and language arts curricula at all school levels. Teachers expect and encourage students to submit writing products as electronic files.
- Between 70 percent and 75 percent of schools believed that word processing programs, video materials, and computer-assisted instruction have improved student performance.
- Some schools are completely revamping their vocational education programs into technology education courses.
- Schools reported that teachers are most comfortable using computers, VCRs, and televisions and are least comfortable using camcorders, CD-ROMs, videodiscs, telecommunications technology, and satellite and distance learning technology.
- Asked about the greatest barriers preventing teachers from using technology for instruction, 79 percent of schools cited lack of funds and 67 percent cited inadequate time to learn, practice, and plan for specific technology uses. In addition, 44 percent cited inaccessibility of technology, 42 percent cited the absence of a technology coordinator, and 41 percent cited lack of curriculum integration training and/or staff development.
- Asked what their greatest technology-related needs were, the largest percentage of schools (72 percent) cited technology training.

advocate for the schools, especially regarding communications and technology vendor agreements.

- *Evaluation.* Evaluation should be part of all instructional technology programs supported by the department of education. The department should systematically collect feedback from the field regarding the use and perceived value of instructional resources and training programs.

Recent Developments

As a result of the CEIT study, enhancements are being made to many longstanding education technology programs, and new efforts are being launched. In particular, the department of education is focusing on ensuring that teachers receive necessary training in using technology effectively.

For example, Jacqueline Mueller said that the department is working closely with state colleges of education to ensure that new teachers "are ready to go into a technology-rich classroom and be successful." The department has helped establish technology training centers in a few of the state's colleges of education, and it maintains a dialogue with the colleges about ways to incorporate technology into students' education experiences. At one teachers' college, graduate students gain valuable experience by providing staff support at the technology training center. Other colleges are providing incentives to instructors who incorporate technology into their own teaching, thereby modeling good practices for their students.

Office of Educational Technology Administrator Peter Lenkway stressed the importance of

these efforts to improve technology training within colleges of education. "School districts now have to spend large amounts of money on retraining the graduates of the colleges of education, because new teachers are not getting the technology training there," he said. "One of the big complaints we are getting about public [higher] education is that business and industry must spend additional money training our graduates. This is the same complaint that public [higher] education has about secondary institutions."

In another initiative springing from the CELT study, the department of education has increased technical assistance in the use of telecommunications and satellite technology. "The CELT study showed that although many schools had these technologies in place, people didn't really know how to use them," said Mueller. Since department staff began visiting schools and offering technical assistance a few years ago, there has been an increase in schools' use of telecommunications and satellites, she said. "We're hoping it was partly as a result of our additional efforts." Also in response to the CELT study, the Florida Information Resources Network has expanded its technical assistance resources by identifying a contact person in each district and training that individual on the use of technology. In addition to FIRN's regular staff of technology experts, "there is now a point of contact in every district where people can go for help," said Mueller.

The Florida Department of Education also has begun making greater user of technology in its administrative activities. For example, the department maintains a web page; makes extensive use of e-mail; uses CD-ROMs to disseminate information on the state curriculum standards to teachers; and conducts some statewide meetings via two-way video, enabling people to participate without traveling. In addition, Commissioner of Education Frank T. Brogan has used teleconferencing technology to address all teachers in the state at the beginning of the school year.

Florida is trying to lay the groundwork for increased use of distance learning by ensuring that equipment purchased by schools around the state is compatible, or "interoperable." To promote such compatibility, the state has developed recommended specifications for school networks. At the same time, the Florida Distance Learning Network has established specifications for various types of equipment. "We want everything to fit together," explained Mueller. "We want everyone to be conscious that when you purchase equipment that potentially could be used for distance learning, compatibility is especially important."

The state legislature has continued to provide annual categorical funding for school technology purchases. For the 1996–97 school year, the legislature appropriated $65.5 million to

How Florida Schools Are Spending State Technology Funds

For the three-year period 1993 through 1996, the state legislature provided $165 million, or $55 million per year, in technology funds to schools. Following is a breakdown of how the schools spent the funds.

Hardware and Software Purchases	(dollars in millions)	Training Purchases	(dollars in millions)
Computers	$62.8	Trainer services and fees	$23.4
Other hardware	19.8	Substitute teachers	7.9
Courseware	16.5	Conference attendance	6.1
Networking resources	11.8	Training materials	5.7
Satellite receiving equipment	3.0	Teacher stipends	5.5
		Other	2.5
Total	**$113.9 (69%)**	**Total**	**$51.1 (31%)**

the department of education for distribution to the state's seventy-one school districts, an increase of about $10 million from the previous year's appropriation. The funds are distributed to each district based on student enrollment.

District Technology Plans

To receive state technology funds, each school district must submit a technology plan, which is reviewed by the Florida Department of Education and the Florida Distance Learning Network. Final approval is given by the commissioner of education. Although the districts do not have to resubmit their entire plan each year, they are required to submit annual updates on any revised sections. Florida education officials said that until current work to develop a statewide education technology plan is completed, the seventy-one district technology plans will constitute the state's technology plan.

According to guidelines developed by the Florida Department of Education and the Florida Distance Learning Network, the district technology plans must include the following essential components:

- a mission statement explaining how the district will promote the use of technology to improve student performance;
- a background section describing the school district and its technology planning process;
- an assessment of infrastructure, equipment, programming, training, and support needs;
- a procurement plan describing the district's plans to acquire software and technology-based educational materials;
- a funding plan identifying the district's major sources of funding for technology, anticipated expenditures related to technology, and funding priorities;
- a technology acquisition plan identifying appropriate technologies for meeting district instructional goals, as well as policies for ensuring, for example, consistency and interoperability among existing and future technology delivery systems and adequate support and maintenance of technology;
- a shared use component describing district policies concerning intellectual property rights, licensing agreements, legal and ethical standards for sharing resources with other education entities, and the development of public-private partnerships;
- an access component describing district policies for ensuring equitable access to technologies for students, teachers, parents, and the community;
- a security component describing policies for protecting student confidentiality, maintaining the integrity of systems, programs, and information resources, and providing physical security for equipment and systems;
- a minimum functionality component describing policies to ensure that technology meets or exceeds state-developed specifications;
- a user support component describing the district's plan for developing and acquiring new programs and software to match curricular needs, providing network management, and ensuring that equipment is maintained and replaced, as necessary;
- a staff training plan that provides for an intensive, ongoing program of professional development to help staff integrate technology into the curriculum, district-level coordination of training and support, and adequate facilities, instructors, materials, equipment, and funding for staff development;
- a program evaluation component describing how the district will evaluate the effectiveness of technology-based programs; and
- a learner assessment component describing procedures for determining the effectiveness of classroom technology in improving student learning.

The legislature's requirement that districts spend 30 percent of their state funding allocations on staff technology training was eliminated effective with the 1996–97 school year. The department still encourages the districts to devote substantial funds to training, but it expects them to do so without a mandate. "We feel that the districts are at a more sophisticated level and are able to make some of

those hard choices [about how to spend state funds] themselves. I think they have seen the value of technology training," said Mueller. Eliminating the 30 percent requirement also fits with the department's overall policy of increasing local control, said Peter Lenkway.

Efforts to Combat Obsolescence

Florida's program to fund school technology purchases has contributed to the state's impressive pupil-to-computer ratio of 6 to 1, though a great number of the computers in schools are obsolete. According to Office of Educational Technology Administrator Peter Lenkway, "If you look at computers that are two years old or less, the pupil-to-computer ratio was 15 to 1 in November 1996, up from 23 to 1 in November 1995, due primarily to greater school district investment in technology." He also noted that a recent study in Dade County, one of the state's most technologically progressive school districts, found that 42 percent of the 31,000 computers in the schools were obsolete. "Some people think that once you spend the money to buy computers, you don't have to do it again," Lenkway said. "But it really needs to get done on a recurring basis."

For the 1997–98 school year, the state legislature increased funding for school technology by another $5 million, for an annual expenditure of $80 million. The state's ongoing efforts to upgrade school computer equipment, together with its continuing focus on providing network connections for schools, promoting distance learning, acquiring and disseminating instructional software, and training educators in the effective use of technology, will keep Florida a leader among states in the integration of technology into education.

Iowa: Strategic Targets Guide Evolving Endeavor

Iowa is a leader among states in using technology to improve teaching and learning, with a statewide fiber optic communications network that will soon connect every school and education institution in the state and numerous other initiatives to promote the use of technology in education. The state department of education has a plan, *Technology for Education in Iowa*, but readers looking for a finely detailed blueprint will be disappointed. "What we have learned is that opportunity outstrips our ability to plan. Instead, we have strategic targets," said Phil Dunshee of the Iowa Department of Economic Development.

Rich Gross, lead consultant to Iowa Star Schools, said he has concluded that the best approach "is to put a framework together that will help us focus and organize our efforts rather than develop a plan in minute detail, because it's going to be changing constantly." Gross advises schools to use the same approach. "As we work with schools, we say that what they really need is a good planning framework rather than a microdesignated plan that's always going to change."

Jodie Butler, education advisor to Iowa Governor Terry E. Branstad, agreed. "Our state plan is always evolving. We're always out there doing the next step. If it sounds confusing, it's because we have a number of things going on simultaneously."

Strategic Targets

Iowa's education technology efforts are centered on six key components that are considered strategic targets. The state's goal is to make continual progress on all six fronts.

- *Infrastructure.* Frequently called the "pipeline," technology infrastructure consists of the wires, fiber optic cable, and telephone lines that carry information and connect classrooms, buildings, and communities across the state.
- *User Technology.* User technology includes the computers and other equipment at the end of the "pipes," for example, a computer, scanner, or digital camera in a classroom.
- *Curriculum.* In Iowa's view, curriculum means the courses, information, places, people, and other resources to which students have access through the use of telecommunications technology. It is the material that "flows through the pipes."

- *Staff Training.* Like many other states, Iowa has come to recognize that technology is only as helpful in the classroom as the teachers who guide its use. Iowa is committed to training teachers and staff on how to use technology to improve teaching and learning.
- *Vision and Planning.* Office of technology officials hold the view that not only the state education agency, but also all school districts and educational organizations, including school board associations, associations of school administrators, and teachers associations, must be involved in creating a vision and making plans for the use of technology in schools. According to an Iowa official, "If the vision and planning occur only at the state level, the effort becomes regulatory and something that's a problem for schools. But if vision and planning are everywhere, then technology becomes part of the culture. Everyone has to be plugged into this process so it will become ubiquitous."
- *Partnerships.* Recognizing that the technology goals and objectives of individual schools and school districts are fusing with those of the larger society, the office of technology is working to promote partnerships among schools, postsecondary institutions, government entities, and private businesses. By building partnerships, the office gains a better understanding of its role, support for its mission, and expanded resources for its activities.

Iowa Communications Network

Iowa has already made significant progress in several of the above strategic areas. However, the state is perhaps best known for the Iowa Communications Network (ICN). This statewide fiber optic communications network is a highly developed, state-of-the-art technology infrastructure.

Iowa Communications Network (ICN) History

1980 Community colleges plan for a small educational telecommunications network using a combination of technologies. The legislative council determines that a coordinated statewide plan for distance learning is needed.

1987 The state legislature authorizes Iowa Public Television to coordinate the Iowa Educational Telecommunications Network , a precursor to ICN.

1989 Governor Branstad proposes and the state legislature approves legislation to create and fund construction of ICN.

1990 The state legislature expands the proposed network to include state agencies and libraries.

1991 Construction begins on Part I, connecting fifteen community colleges, three regents institutions, Iowa Public Television, and the state capitol complex.

1992 Construction begins on Part II, connecting the community colleges to the remaining eighty-four "county points of presence."

1993 Parts I and II are completed.

1994 The state legislature establishes a governance and management structure for the network, the Iowa Telecommunications and Technology Commission; authorizes hospitals, physician clinics, the federal government, the judicial department, and the U.S. Postal Service to use the network; and establishes the guidelines for the development of Part III of the network.

1995 The state legislature approves a $94.7 million Part III plan to connect 474 sites, using primarily privately leased lines, and commissions a study of the feasibility of selling ICN or converting it to a public utility.

Legislation to create and fund construction of the network was proposed by Governor Branstad in 1989 and approved by the legislature the same year. Construction began in 1991 and has proceeded in three stages. The first stage connected the hub of the network, near Des Moines, to all fifteen community colleges, which serve as regional switch sites, and the three state universities. The second stage connected the regional switches to all of the state's ninety-nine counties as well as to state and federal agencies. The third stage, which is still underway, will connect the county high schools and libraries to the network. A state telemedicine initiative also encourages hospitals and clinics to connect to the network.

It cost Iowa around $100 million to complete the first two stages of the network. It is estimated that the third stage, which will involve leasing lines from several telecommunications vendors, will cost about $95 million. In addition, all network subscribers are required to furnish their own classroom technology at a cost of roughly $50,000 per classroom.

Around 400 sites are currently connected to ICN. The number of sites is expected to increase to 800 by 1999. By 2000, ICN is scheduled to have at least one point of presence in every school district in Iowa. Authorized users of the network include all accredited kindergarten through grade twelve school districts, both public and private; all accredited public and private colleges and universities and community colleges; public libraries; all state and federal government agencies; the U.S. Postal Service; and, for telemedicine purposes only, hospitals and physician clinics. To ensure that all school districts, regardless of wealth, have access to the educational opportunities provided by ICN, the state subsidizes education users of the network.

The network has impressive capacity. Having a backbone of forty-eight DS-3 circuits, with each DS-3 circuit being equivalent to twenty-four T-1 circuits, the network provides an individual user with 6,755 times the capacity of a regular telephone line. The result of this huge capacity is that many classrooms can access the network at the same time without delays.

Faith That Applications Would Follow. "The primary mission of ICN is to furnish a technological platform that gives the education community in Iowa the ability to integrate technology into the curriculum, based on each school district's needs, at very low-cost, subsidized rates," stated Harold "Tommy" Thompson, chief operating officer of ICN. Designing a large-capacity system was the state's way of ensuring against obsolescence. Building it "big" reflected Iowa's recognition that there were understandable uncertainties about future needs and that an open architecture system could grow with the advancements in technology. According to Phil Dunshee of the Iowa Department of Economic Development, "When we started with this network, we couldn't envision the applications available today nor with any certainty the multimedia and data applications of the future."

Many states would be reluctant to go forward with such an expensive technology investment without a clear plan for how the system would be used. However, Iowa policymakers are comfortable with the approach they took, an approach that Dunshee noted was "exactly opposite" of the way policy decisions usually are made. "We started with the idea that you have to have the basic infrastructure. There was a certain amount of faith and confidence that if you build it, the applications will follow," said Dunshee.

That faith has paid off. "In the time it's taken to build the network, the technology has changed so much that there are applications we're using today that nobody even dreamed about when we started," said Dunshee. Today the system provides full-motion video, compressed video, high-speed data, and voice transmissions.

The network is used for many purposes. Education facilities, ICN's largest group of users, employ it for semester-long distance learning courses, meetings, staff development sessions, and continuing education courses for professionals. State agencies and higher education

institutions provide workforce education and training sessions for Iowa businesses over the network. State government uses ICN for meetings and court proceedings; the medical community uses it for education and for consultations between rural physicians and hospital specialists; and the Iowa National Guard uses it for training.

Since December 1995, ICN also has been an Internet provider. To promote equitable access for all users and ensure that the network accomplishes its intended purpose of advancing education, Iowa policymakers have established low prices for Internet use. Rates for education users are $5 per hour for elementary and secondary schools and $6 per hour for postsecondary institutions. State subsidies pay for the remaining actual costs, estimated at around $45 per hour. State agencies pay $10 per hour, while other users pay the full $45 per hour.

ICN use has grown steadily. From fiscal 1993 to fiscal 1996, annual video use increased from 26,000 hours to 101,000 hours. It is estimated that use will increase to 168,000 hours annually in fiscal 1997 and jump to 275,000 hours annually in fiscal 1998.

This success accounts for the most formidable problem facing ICN—there are not enough video sites to meet the rising demand for service. This situation is expected to improve as the state funds additional hookups during the next few years.

Designed for Education. Although the Iowa Communications Network now serves several different sectors, including education, government, emergency management, and medicine, originally it was designed primarily for education. Consequently, it serves the education community's needs particularly well. Rich Gross discussed the value of having Iowa educators define very clearly what they needed from an advanced communications and technology system before the department approached the companies that would build the network. "We took an approach that I would still recommend today that everybody use. We convened a statutorily created "Narrowcast Advisory Committee" representing all levels of education—public, private, higher education, and elementary and secondary education—and we said, 'Design a system.' We did not go to industry and ask what it could offer and then come back to [members of] the education community and ask how we could adapt what they were doing to the industry system. Instead, we first designed a system and then asked industry to develop something that could serve those needs."

Gross believes that if the education community took such an approach more often "we could probably have a lot more products specifically oriented to our needs rather than adapting technology that was developed first for other purposes." He added that this approach ultimately also benefited industry, with some of the subcontractors who built ICN developing new patentable products as a result of the experience.

Phil Dunshee stressed the importance of state policymakers thinking through exactly what

Iowa Communications Network (ICN) Operations

- ICN's fiscal 1995 operating budget was $14.5 million. Revenues were $9.2 million. The state paid for the $5.3 million difference through a supplemental appropriation.
- From fiscal 1992 through fiscal 1996, ICN received $65.5 million from the state legislature.
- ICN currently employs ninety-three people full time to manage, supervise, and maintain network operations. Employees include twelve administrative staff, twenty engineers, twenty-one financial staff, seven outside plant and construction staff, fifteen operations and planning staff, fifteen network services staff, and three public affairs staff. ICN also employs five part-time commissioners.

they are trying to accomplish through technology before approaching vendors. "Vendors say that the biggest problem they have in working with states is that states aren't very good at defining what they want to do," Dunshee said. "Vendors will say, 'We can design for you, but first you have to tell us your priorities and what you want to accomplish.' You have to be really clear about what you want to achieve . . . . We're at a very exciting period. But we also have to be very focused and set our priorities. The strategic planning process [and] the articulation of our goals—all of these things become key."

School Improvement Technology Program

To take advantage of ICN and tap the other educational powers of technology, Iowa schools need to acquire many more computers and other equipment. In addition, teachers and administrators need to think about how they will use these expensive, powerful technological resources to improve teaching and learning. In April 1996, Governor Branstad signed the Iowa School Improvement Technology Act (SF 2063) to help schools accomplish both of these goals.

The act created the School Improvement Technology Program to fund the purchase of instructional technology in public schools. Under the program, school districts will receive $30 million a year for five years—fiscal 1997 through fiscal 2001. To receive funds under the program, a school district must develop a multiyear technology plan tied to its school improvement goals and explain how district schools will use technology to improve teaching and learning. The Iowa Department of Education views this as an essential feature of the law. "The bottom-line question with everything in a state education technology program is, how is it going to improve teaching and learning? If you cannot tie what you are doing directly to that, then it's not worth pursuing," said Rich Gross.

The act does not specify what items schools should purchase with the technology funds, reflecting the education department's belief that these decisions are best made by the schools. Nor does it require schools to list their planned purchases in their technology plans. "What we don't want to see in a technology plan is a list that says, 'We're going to buy six IBMs and ten Macs, etc.,' " said Gross. "What we really want to know is how the school is going to use the technology to move ahead to improve teaching and learning."

To accommodate the fact that technology is constantly evolving, the act allows schools to carry over funds received in one fiscal year to subsequent fiscal years. This eliminates what Gross called "the June 15 push to dump money," allowing a school to wait two or three years before making a large technology investment.

In addition, the act allows schools to lease equipment instead of purchasing it. This provision, which represents a change from the state's usual policy of prohibiting leasing by schools, is intended to help schools avoid the problem of spending large sums of money on equipment that becomes obsolete in just a few years.

Finally, the act specifies that funds may be used for acquiring technology equipment, installing and maintaining hardware and software, purchasing materials and supplies related to instructional technology, and providing staff development and training. These provisions recognize that there are many costs related to operating an effective instructional technology program besides the initial cost of acquiring computers.

Other Efforts to Promote the Effective Use of Technology in the Classroom

Iowa has several initiatives designed to ensure that technology is used in the classroom to provide exciting, high-quality learning experiences for students. The Iowa Showcase program, run by the department of education and now in its third year, provides $1,000 stipends to teachers who develop effective uses of technology in the classroom. From the nominations received by the department, of which there have been more than 300 a year, a panel selects 25 exemplary uses of technology. These winning ideas are then published in a book

and posted on the World Wide Web so that other teachers can learn from them.

One of the exciting ideas that surfaced through the Iowa Showcase competition was a class project in which students built a home page that describes the history of their community. In another example, a teacher helped his class use the Internet to learn about the NASA Mars rover project and then had the class develop designs for a Mars rover. The first Iowa Showcase competition illustrated that a surprising number of elementary and secondary education teachers were already heavily involved in using the Internet as an education resource.

In addition, in 1997 the department plans to select a school to work with the department for three years to create and test new uses of technology in the classroom and new approaches to staff training. The pilot school will also serve as a contact point for other schools interested in learning about the new applications.

Finally, the department hopes to develop a program to involve the higher education community in the technology efforts of the elementary and secondary education system. The program would seek support from colleges and universities in areas such as software development, software review, preservice training, teacher inservice programs, and research.

The Role of Political Leadership

Iowa policymakers stressed the important role that strong legislative and gubernatorial support have played in the development of the state's education technology program and the passage of the Iowa School Improvement Technology Act. "There was key bipartisan support on both the house and senate education committees, and I think that was crucial," said Gross. "This whole thing moved as quickly and easily as it did because there was broad-based bipartisan support, which I think needs to be a model in other states and at the national level." Gross added that lawmakers of both parties were influenced particularly by arguments that a strong education system would help ensure the overall economic vitality of the state.

Governor Branstad's highly visible, long-term support for education technology is the other chief reason for Iowa's remarkable progress. "A Governor's leadership and vision are critical to accomplishing anything in this arena," said Jodie Butler. "The Governor's use of the bully pulpit is crucial to sustaining the vision for technology over time. In Iowa this kind of vision and leadership have led to a number of our successes."

Lessons Learned

Asked what state policymakers might do differently if they were starting all over again, Gross said that in building ICN it would have been wise to focus more on how the network would be used to improve education. In seeking funding for the network from the state legislature, "we were probably focused too much on the technology and the infrastructure and not enough on the applications and benefits." As a result, Gross said, construction of the network "became much more controversial within the general assembly than it needed to be."

Gross credited Governor Branstad's strong leadership in gaining approval for the network. "We were very fortunate to have a Governor who saw this as a priority and helped to shepherd it through. If that weren't the case, I don't think we would have ever gotten it put together." In addition, Gross said that although Iowa is working to train educators on the effective use of technology, the state needs to focus even more attention on this task. "We have not paid as much attention to faculty development as we should have . . . . We need to think of teacher training beyond a half-day workshop once a year and begin to think [about] how it is part of the profession."

North Carolina: State Plan Provides Overarching Framework

North Carolina's approach to technology planning can best be described in two words—methodical and deliberate. Unlike in Iowa and Florida, where numerous technology programs and initiatives are thriving despite the

lack of an overarching state plan, in the early 1990s North Carolina lawmakers decided that a comprehensive state education technology plan was needed to ensure the targeted and effective use of state technology dollars. Today, this state plan governs all local school technology initiatives.

"I felt that we shouldn't put any money into technology until we had a plan," explained North Carolina State Senator Leslie Winner, a leading advocate for the state's education technology effort. James Watts, an education specialist and staff member of the house and senate education committees, explained the general assembly's insistence on a plan more bluntly. "We've wasted a hell of a lot of money in this state on technology and members [of the legislature] are not likely to keep on investing unless they see some priority concerns taken care of."

Planning

Work on creating the state plan began in 1993, when the state legislature created the North Carolina School Technology Commission and directed it to develop a school technology plan to improve classroom instruction. At that time, North Carolina lagged far behind many other states in integrating technology into education. A study conducted by the commission in preparation for developing the statewide plan found that the use of technology in North Carolina schools was fragmented and inequitable. Only about 20 percent of schools had a comprehensive technology plan to support teaching and learning, and few schools had a technology infrastructure sufficient to support an effective range of technology tools and applications. The study, which was conducted with assistance from the Center for Educational Leadership and Technology (CELT), also found that most teachers had very little access to technology and had not been trained effectively to use existing technology. Further, teacher preparation programs neither were adéquately equipped nor prepared to provide proper staff development and training in technology, and recent graduates of North Carolina schools of education were not prepared to integrate technology into the teaching process. All of these findings confirmed the need for the state to assume a leadership role in putting technology in schools and fostering its effective use.

The plan developed by the North Carolina School Technology Commission is titled the *North Carolina Instructional Technology Plan.* Approved by the state board of education in February 1995, it outlines several major steps to address the technology problems facing the public schools. The recommendations include the following.

- All local school districts should develop a five-year technology plan based on state criteria. The state plan specifies the components that must be included in the local plans and provides detailed guidance to school districts on a process for developing the components.
- The general assembly should allocate up to 10 percent of each school district's state-appropriated funds for the development of local plans. In addition, the general assembly should assist districts in their planning efforts by appropriating $450,000 for planning support services and electronic planning tools and templates.
- Schools should work together at the local, regional, and state levels to procure equipment, support personnel, maintenance services, and other equipment and services at dramatically reduced rates.
- The commission and the department of public instruction should develop new models and networks for the delivery of staff development activities to enable teachers to integrate technology into the teaching process. In addition, school districts should allocate between 20 percent and 30 percent of their total technology program costs to staff development and training.
- The state board of education should review policies that relate to the exit competencies of preservice teachers. The board should work with institutions of higher education to develop an implementation schedule to ensure that graduates demonstrate desired

technology competencies before obtaining initial teacher certification.

- The state should develop evaluation procedures to monitor the implementation of the state instructional technology plan and evaluate its impact on student achievement.
- The state should appropriate $381 million to carry out various education technology initiatives.

Implementation

The state has taken action on many elements of the state plan. During the 1995–96 school year, each of the 118 local school systems developed a five-year instructional technology plan. The plans include strategies and timelines for acquiring technology, achieving instructional objectives, training staff, providing maintenance, and renovating facilities, as well as descriptions of the technology's expected impact on student learning, student workforce readiness, and teacher productivity.

The districts had a strong incentive to complete and submit these local plans. Under the state plan, no district may receive state technology funds unless its long-term technology plan is approved. The district plans were submitted to the state board of education, which reviewed the curriculum and content aspects of the plans, and the Information Resources Management Commission, which reviewed the technical aspects of the plans. All of the district technology plans have now been approved by these two entities.

Legislative aide James Watts believes that the process for developing and approving district plans strikes a good balance between state and local concerns. "It provides for some degree of local flexibility, yet ensures that some state priorities are met. Those state priorities include cost-effectiveness, compatibility of equipment, and the need for technology that's open-ended enough to be flexible over the long haul."

Governor James B. Hunt Jr. also has forged a strong partnership with business and industry to promote higher standards. Clearly, technology is one of the cornerstones of these efforts. The Governor co-chaired the 1997 North Carolina Business Summit for Education, resulting in a commitment to support the state's education technology fund. The North Carolina School Improvement Panel also will be hosting twenty to twenty-five community meetings to address the issues discussed at the summit, including the role that technology should play in helping students learn. Governor Hunt is supporting this effort to help ensure implementation of the actions discussed at the summit.

North Carolina also has made progress in promoting both preservice and inservice technology training for teachers. In October 1995, a School Technology Users Task Force, composed of representatives from the state's elementary and secondary education, community college, and university systems, identified the technology-related skills, or "competencies," that inservice educators should master. Based on the task force's recommendations, the state board of education now requires that teachers seeking recertification obtain three to five credit hours in these competencies, as deemed appropriate by their local school district.

As noted by Margaret Bingham of the department of public instruction, this arrangement is another example of North Carolina's effort to blend state mandates with local control: "Not every competency may be required by the local unit for every teacher, and the three to five units can be interpreted as thirty to fifty hours of training," Bingham explained.

The department of public instruction and the state board of education also are working to ensure that new teachers learn these same technology competencies. A Teacher Assessment Project is developing a technology assessment that will be given to candidates for North Carolina licensure beginning in spring 1998.

To support preservice technology training, in 1995 the legislature provided the University of North Carolina system's fifteen schools and departments of education with a one-time special appropriation of $3.1 million—$1.5 million for technology equipment and $1.6 million to enable each school to hire a technology expert.

North Carolina Technology Competencies for Educators

Basic Competencies

1.0. Computer Operation Essential Knowledge and Skills

Demonstrate these skills:

1.1. Start up and shut down computer system and peripherals.
1.2. Identify and use icons, windows, and menus.
1.3. Start an application and create a document.
1.4. Name, save, retrieve, and revise a document.
1.5. Use printing options.
1.6. Insert and eject floppy disk and CD-ROM.
1.7. Initialize, name/rename floppy disk and hard disk.
1.8. Copy document from hard disk to floppy disk and vice versa.
1.9. Create and name/rename subdirectories/folders.
1.10. Save, open, and place documents inside subdirectories/folders.
1.11. Open and work with more than one application at a time.
1.12. Use special operating features for people with disabilities.

Demonstrate knowledge through practical application:

1.13. Terms such as graphical user interface, document, application, K (kilobyte), hierarchical file system, directory, operation system, system software, and RAM.
1.14. Storage capacity of floppy/hard disks, CD-ROMs.
1.15. Similarities/differences and advantages/disadvantages of various operating systems.

Expanded Knowledge and Skills.

Demonstrate these skills:

1.16. Make more memory available.
1.17. Install/reinstall and update system software and printer drivers.
1.18. Exchange disks and files among Macintosh, MS-DOS/Windows, and Apple II computers.

2.0. Setup, Maintenance, and Troubleshooting Essential Knowledge and Skills

Demonstrate these skills:

2.1. Set up computer system and connect peripheral devices.
2.2. Protect and care for floppy disks.
2.3. Clean computer components and printer.
2.4. Make backup copies of key applications and documents.
2.5. Use self-help resources to diagnose and correct common hardware/printing problems.
2.6. Install and upgrade an application.

Demonstrate knowledge through practical application:

2.7. Proper operating environment for computer and peripherals.
2.8. Protection against computer viruses.
2.9. Technical assistance resources available at local level.

3.0. Word Processing/Introductory Desktop Publishing Essential Knowledge and Skills

Demonstrate these skills:

3.1. Enter and edit text and copy and move a block of text.
3.2. Copy and move blocks of text.
3.3. Change text format and style and set margins, line spacing, and tabs.
3.4. Check spelling, grammar, and word usage.
3.5. Create a header or footer.
3.6. Insert date, time, and page number.
3.7. Add columns to document
3.8. Insert clip art into document.

Demonstrate knowledge through practical application:

3.9. Terms such as cursor, format, font, style, header, footer, and spelling checker.

4.0. Spreadsheet/Graphing Essential Knowledge and Skills

Demonstrate these skills:

4.1. Interpret and communicate information in an existing spreadsheet.
4.2. Enter data in an existing spreadsheet.
4.3. Create a spreadsheet with rows, columns, and headings.

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North Carolina Technology Competencies for Educators *(continued)*

4.4. Create/copy formulas and functions to perform calculations.

4.5. Create a graph from spreadsheet data.

4.6. Insert a spreadsheet into a word processing document.

Demonstrate knowledge through practical application:

4.7. Terms such as spreadsheet, cell, data entry bar, formula, and function.

5.0. Database Essential Knowledge and Skills

Demonstrate these skills:

5.1. Use information from an existing database.

5.2. Sort a database by specific fields and add and delete records.

5.3. Create database with multiple fields and records.

5.4. Create custom layouts, including columnar reports.

5.5. Insert database fields into word processing document.

Demonstrate knowledge through practical application:

5.6. Terms such as database, field, record, layout, sort/arrange, search/select/filter, and mail merge.

6.0. Networking Essential Knowledge and Skills

Demonstrate these skills:

6.1. Use a file server (connect/log on, retrieve a program or document, and save a document to a specified location).

6.2. Share files with others on a network.

Demonstrate knowledge through practical application:

6.3. Terms such as local area network, wide area network, access rights, security passwords, file server, and zone.

Expanded Knowledge and Skills.

Demonstrate these skills:

6.4. Select/deselect a network zone.

7.0. Telecommunications Essential Knowledge and Skills

Demonstrate these skills:

7.1. Connect to the Internet or an online service.

7.2. Use electronic mail (compose, send, retrieve, read, and respond).

7.3. Access and use resources on the Internet and World Wide Web.

Demonstrate knowledge through practical application:

7.4. Terms such as telecommunications, direct access, dial-in access, modem, baud rate, Internet, and World Wide Web.

7.5. Obtain/maintain an account on the Internet or an online service that provides Internet access.

7.6. Online conferences relevant to professional information needs.

7.7. Use of Telnet to connect to a remote computer on the Internet.

Expanded Knowledge and Skills.

Demonstrate these skills:

7.8. Connect a computer to a modem and telephone line for dial-in access.

7.9. Install and configure telecommunications software.

7.10. Upload a text file and send as electronic mail.

7.11. Use specialized e-mail lists relevant to professional information needs.

7.12. Create and use group addresses for electronic mail.

7.13. Read, save, print, reply to, and forward electronic mail.

7.14. Use a gopher to browse resources on the Internet.

7.15. Use FTP to send or retrieve files from remote computers.

7.16. Use effectively distance learning, desktop videoconferencing, and teleteaching technologies.

8.0. Media Communications (Including Image and Audio Processing) Essential Knowledge and Skills

Demonstrate these skills:

8.1. Produce print-based products (e.g., newsletters, brochures, posters, books).

8.2. Produce electronic slides/overheads.

8.3. Set up and operate a videocassette recorder/player and monitor/TV.

8.4. Connect a video output device (e.g., LCD panel) to computer for large screen display.

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North Carolina Technology Competencies for Educators *(continued)*

Demonstrate knowledge through practical application:

8.5. Terms such as painting tool, drawing tool, and compression.

8.6. Role of media in effective communication.

8.7. Characteristics, strengths, and weaknesses of different media.

8.8. Consumer issues, including identification/evaluation of available media communication resources.

Expanded Knowledge and Skills.

Demonstrate these skills:

8.9. Use painting and drawing tools.

8.10. Use digital camera and scanner.

8.11. Use camcorder and edit video from a camcorder.

8.12. Produce a video.

8.13. Set up and operate a videodisc player and TV receiver or monitor.

9.0. Multimedia Integration Essential Knowledge and Skills

Demonstrate these skills:

9.1. Use a linear multimedia presentation.

9.2. Use a nonlinear, hypermedia presentation.

Demonstrate knowledge through practical application:

9.3. Terms such as media, multimedia, hypermedia, and clip media.

Expanded Knowledge and Skills.

Demonstrate these skills:

9.4. Plan/produce a linear multimedia presentation.

9.5. Plan/produce a nonlinear, hypermedia presentation.

9.6. Use a file compression utility.

9.7. Input and digitize sound from microphone and audiocassette player/recorder.

9.8. Create simple animations.

Advanced Competencies

10.0. Curriculum Essential Knowledge and Skills

Demonstrate these skills:

10.1. Use the computer skills curriculum to identify what students should know and be able to do.

10.2. Use school television resources that support the curriculum.

10.3. Access resources for planning instruction available via telecommunications (e.g., experts, lesson plans, authentic data, and curriculum materials).

Demonstrate knowledge through practical application:

10.4. Goals of the North Carolina Computer Skills Curriculum.

10.5. The North Carolina Skills Assessment.

Expanded Knowledge and Skills.

Demonstrate these skills:

10.6. Locate, evaluate, and select appropriate teaching/learning resources and curriculum materials for the content area and target audience, including computer-based products, videotapes and discs, local experts, primary documents and artifacts, texts, reference books, literature, and other print sources.

11.0. Subject-Specific Essential Knowledge and Skills

Demonstrate these skills:

11.1. Use technology in the discipline/subject for learning and as a medium for communications.

11.2. Use media and technology to present the subject so that it is comprehensible to others.

11.3. Use technology-based tools that are specific to the discipline.

11.4. Use technology to facilitate teaching strategies specific to the discipline.

12.0. Design and Management of Learning Environments/Resources Essential Knowledge and Skills

Demonstrate these skills:

12.1. Develop performance tasks that require students to (a) locate and analyze information, as well as draw conclusions, and (b) use a variety of media to communicate results clearly.

12.2. Use computers and other technologies effectively and appropriately to collect information on student learning using a variety of methods.

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North Carolina Technology Competencies for Educators *(continued)*

12.3. Use computers and other technologies effectively and appropriately to communicate information in a variety of formats on student learning to colleagues, parents, and others.

Demonstrate knowledge through practical application:

12.4. Physical settings that support active student involvement, inquiry, and collaboration.

12.5. Organizational and management strategies that support active student involvement, inquiry, and collaboration.

12.6. Resources available, including satellite, cable, wireless, and ITFS (Instructional Television Fixed Service).

Expanded Knowledge and Skills.

Demonstrate these skills:

12.7. Select and create learning experiences that are appropriate for curriculum goals, relevant to learners, based on principles of effective teaching and learning; incorporate the use of media and technology for teaching, where appropriate; and support learner expression in a variety of media using a variety of media communication tools.

13.0. Child Development, Learning, and Diversity Essential Knowledge and Skills

Demonstrate these skills:

13.1. Use media and technology to address differences in children's learning and performance.

13.2. Use media and technology to support learning for children with special needs.

13.3. Use media and technology to support learning for children whose primary language is not English.

13.4. Use appropriate local, state, and national services or resources to meet diverse learning needs through technology.

14.0. Social, Legal, and Ethical Issues Essential Knowledge and Skills

Demonstrate these skills:

14.1. Establish classroom policies and procedures that ensure compliance with copyright law, fair-use guidelines, security, and child protection.

14.2. Ensure equal access to media and technology resources for all students.

Demonstrate knowledge through practical application:

14.3. Social, legal, and ethical issues related to technology use.

Recommended by the North Carolina School Technology Users Task Force in October 1995 and approved by the North Carolina State Board of Education in March 1996.

The purpose of the funding was to help the university system do a better job of teaching future educators how to use technology to enhance learning in the public schools.

The state also has begun a program to test eighth graders on cumulative technology skills learned in kindergarten through grade eight. The state-designed assessment, which is based on technology competencies identified in the state curriculum, requires students to perform tasks and solve problems that involve word processing, database, and spreadsheet skills. Beginning in 2001, all North Carolina public school students will be required to have passed the eighth-grade-level technology assessment to graduate from high school.

Low Funding Levels Hamper Progress

Efforts to implement the state plan are moving more slowly than some would like, due mainly to a lack of state funds. Although in 1994 the general assembly appropriated $42 million to enable school districts to begin implementing their technology plans—the funding level recommended in the state plan for first-year efforts—since then appropriations have left school technology supporters sorely disappointed. Despite the state plan's recommendation of $71 million in second-year funding and $73 million in third-year funding, the legislature appropriated no funds for school technology in 1995 and only $20 million in 1996.

Low appropriation levels have made it difficult for local school districts to implement their technology plans, a fact noted by the state board of education in an October 1996 report to the state legislature. According to a legislative staff member, the Governor's proposed education budget for fiscal 1997–99 would commit most available funds to raising teacher salaries. "There's just not much money left for technology," the aide said.

Lessons Learned

North Carolina State Senator Leslie Winner offered her views on why the legislature has not appropriated more funds for implementing the state technology plan. "I think one of the real problems in North Carolina is that there haven't been enough legislators who are committed to [education technology] and feel some investment and ownership of the issue." Looking back, Winner believes that there would be stronger legislative support today if more members had been involved in developing the plan along with the educators who served on the North Carolina School Technology Commission. "What I would say is, it's great to do a wonderful plan. But you somehow have to do a better job than we did in building up the commitment to fund the plan. You need to think through at the front end how you're going to end up with enough people committed to the plan so that it actually gets funded."

Legislative aide James Watts added that general assembly members seem to be unconvinced about the educational benefits of technology. "The most common question I get is, 'What can technology produce in terms of kids learning?' Our people are extremely focused on student achievement in the core academic areas. They want to see a connection." Watts suggested that the people requesting technology funds, including the state board of education, the department of public instruction, and the local school districts, need to do a better job of demonstrating to lawmakers that money spent on technology will have a direct impact on student learning.

Despite the funding problems, State Senator Winner sees a value in having required the school districts to develop local implementation plans. Noting that some school systems are able to obtain money for technology from other sources, such as local education funds and the PTA, she said, "Now at least they have a plan to [which they can] apply the money so that their technology efforts aren't so random."

Winner also praised a decision by the state legislature to set aside appropriated technology funds in a nonreverting trust fund rather than allocating the funds directly to schools. This approach relieved the school districts of the pressure to spend the money before the fiscal year ended, giving them time to plan carefully. "What we wanted to say to the school systems was, 'Take your time, do your plans right, and this money will be waiting for you when you are ready.' I think that was one of the best things we did."

Key Concerns

Winner's main concern, in addition to securing more funding, has to do with the state's ability to provide high-quality staff development for teachers. Although Winner is pleased with the state plan requirement that school districts spend at least 20 percent of their state technology funds on staff development, she fears that the kind of high-quality staff development needed to help teachers maximize the instructional potential of technology may not yet be available in North Carolina. "We can teach them how to do keyboarding and word processing and spreadsheets and how to access the Internet and what a search engine is," Winner said. "We are competent in those areas. What I don't think we have figured out how to do is take our 70,000 teachers and teach them how to integrate technology into the curriculum in a way that will improve student learning, which is, after all, the goal."

Utah: Grassroots Support and Gubernatorial Vision Are Keys to Success

The Governor, state legislators, state office of education staff, and state education leaders believe that with information technology

affecting nearly every sector of Utah's economy, they would be doing Utah children a serious disservice not to familiarize them with technology beginning at an early age. "We're preparing the kids for what's ahead of them," said Vicky Dahn, coordinator of instructional technology for the Utah State Office of Education. When people ask her why the state is spending so much money on technology, she points out the huge impact that technology is having on people's everyday lives. "I ask, 'Have you visited the grocery store lately? Have you visited the bank lately? Have you visited any enterprise that is not affected by technology? Do you expect your kids to be competitive in this technological era without ever having touched a machine?'" It is an argument that has been embraced fully by Utah Governor Michael O. Leavitt, as well as by the state legislature, which has provided funds for education technology for more than a decade.

Utah Educational Technology Initiative

Utah's push to integrate technology into the teaching and learning processes began in earnest in 1990 with the legislature's enactment of the Utah Educational Technology Initiative (House Bill 468). The legislation authorizes funding to enable schools to purchase technology.

A funding formula in the statute calls for 25 percent of the funds to be divided equally among the state's school districts, and the remaining 75 percent to be allocated according to each district's estimated average daily enrollment for the current year. This distribution formula is intended to ensure equity across large and small school districts.

To receive funds, school districts initially were required to prepare four-year technology plans specifying, for example, the equipment the district intended to purchase and the educational goals to be served by the technology. These district plans were submitted to the educational technology initiative project office and reviewed by a technical review committee. Before funds could be released to a district, the plan had to receive final approval from the initiative steering committee. Districts also were required to submit year-end reports indicating how the funds were spent and how the purchased technology was being used to reach the performance goals outlined in the district technology plan. With this initial four-year planning period completed, districts are now required to submit new, five-year plans addressing instructional focus, maintenance, UtahLINK connectivity, staff training, and evaluation procedures.

The Utah Educational Technology Initiative has received supplemental appropriations every year since it was established. As of the 1996–97 school year, the legislature had appropriated $60 million in supplemental funds for the

Utah Educational Technology Initiative Funding History

Year	Supplemental Funds *(for technology purchases)*	Line-Item Funds *(for maintenance)*
1990–91	$15,000,000	$0
1991–92	13,900,000	0
1992–93	11,000,000	0
1993–94	9,900,000	1,000,000
1994–95	7,500,000	1,015,000
1995–96	2,700,000	4,419,162
1996–97	0	6,400,000
Total	**$60,000,000**	**$12,834,162**

Utah Education Network Mission Statement

"It is the mission of the Utah Education Network to provide the citizens of Utah access to the highest quality, most effective instructional experiences, administrative support services, library services, student services, and teacher resources, regardless of location or time. These services will be delivered through seamless, technology-rich, communications networks linking schools, world information networks, business, industry, and homes."

initiative. In addition, in 1993 the legislature established a line item in the state budget to fund school districts' costs for repairing, replacing, and upgrading hardware and software purchased through the initiative. As of the 1996–97 school year, the legislature had appropriated $12.8 million for this line item.

The main problem the initiative now faces is that technology installed during the early years of the program is aging. During the first two years of the initiative, hardware-hungry schools opted to buy more central processing units with less computing power, leaving many schools with obsolete equipment. To prevent further purchases of older architecture, the technical review committee has since tightened its purchasing standards.

Grassroots Beginnings

Vicky Dahn of the state education office explained that the Utah Educational Technology Initiative resulted primarily from the efforts of educators, businesspeople, and parents, who were concerned that students were not getting enough exposure to technology in school to prepare them for work in the state's technology-oriented economy. It was this group of citizens that presented legislators with the proposal for a statewide educational technology program, which became the basis of the 1990 legislation establishing the initiative.

"It was a grassroots-business collaborative effort that launched the Utah Educational Technology Initiative, and the initiative has been funded every year since then," said Dahn. "I think the strength of our plan is that it wasn't concocted by some department of education person. It came from the people who vote, decide, and care." Dahn added that the proposal was supported by the Governor, the public education and higher education communities, the business community, the Utah State Office of Education, and local school districts. "So all of that wonderful collaboration that sometimes never happens had already fallen into place prior to the launching of the formal technology plan."

Dahn also noted that the initiative has received a crucial boost from Governor Leavitt, who has enthusiastically led efforts to gain additional funding for the initiative. "He has just ramrodded technology through. It's been a delight to sit back and let him speak on behalf of technology in the schools." With Governor Leavitt leading the way, she said, "We don't have to do a lot of hand-wringing anymore over whether we will get money for the initiative every year."

Dahn added that although Governor Leavitt does not have a background in technology, "He wasn't intimidated by it. He saw a vision of what could happen." In particular, Governor Leavitt saw the potential for technology to reduce crowding in the classroom and preclude the need for new school construction in a state that is experiencing a huge boom in the number of school-age children.

Utah Education Network

Although the Utah Educational Technology Initiative provides funds for schools to purchase technology and train teachers, the mission of the Utah Education Network is to ensure the availability of online instructional programs, live video courses, and other distance learning opportunities to go along with the computers and other equipment.

Utah Education Network Objectives

- Provide long-term vision, leadership, management, planning, and advocacy for statewide distance learning and information technologies that complement the state's education effort.
- Provide coordinated access to the highest possible quality instructional and informational programming and content materials that support a world-class curricula and serve to prepare students for the future.
- Serve as a clearinghouse for programming and content services and work with institutions and private providers to share in content development.
- Coordinate training efforts and develop workshops and training sessions on the effective use of network services to enhance teaching and learning experiences in the classroom, in cooperation with the state office of education, the state board of regents, and Utah educators.

Established by the state legislature in 1993, the Utah Education Network uses technology to give all Utahns, regardless of where they live, access to educational courses and services offered by Utah schools, colleges, applied learning centers, and universities. The network is funded primarily through state legislative appropriations, with additional support from the Corporation for Public Broadcasting, television station KUED, foundation grants, and other sources. The network's budget for 1996–97 is $13.2 million. It is operated as a consortium by the Utah State Office of Education, the Utah System of Higher Education, state government, business, and industry. It is accountable to the state legislature, the Governor's office, the state board of regents, and the state office of education.

The Utah Education Network is a particularly valuable resource for Utah's rural high schools, which typically do not offer as many courses as some of the state's larger urban and suburban schools. Through its computer, video, and broadcast systems, the network enables rural students to take exciting classes, such as Russian, Shakespeare, and applied communications.

The network's educational opportunities are provided through three delivery systems.

- EDNET, a closed-circuit system of interactive television, enables students and teachers to see, hear, and communicate with one another from different EDNET sites.
- UtahLINK, a statewide computer network and educational web site, provides Internet access and links to educational sites worldwide, as well as access to educational resources for teachers and students, including the state's core curriculum, online lesson plans and courses, full-text library databases, and career and college information.
- Instructional television stations KUED-7 and KULC-9 broadcast educational programs for use by elementary and secondary teachers in the classroom, as well as for-credit college telecourses.

EDNET. The EDNET system reaches 155 sites throughout Utah using television monitors, video cameras, microphones, telephone lines, fiber optics, and microwave links. All public universities, colleges, and applied technology centers are connected, and all high schools that request the system will be connected by the end of 1998.

The system provides many different services for various groups. For example, high school and college students can take courses offered by distant schools and universities. Recent offerings included American Civilization, offered on the system by the College of Eastern Utah; College Algebra, offered by the Utah Basin Applied Technology Center; and Advanced Health Science, offered by Weber State University. In addition, EDNET provides access to professional development workshops and seminars for

teachers, administrators, and other public employees, as well as daily continuing medical education classes offered by the University of Utah School of Medicine. EDNET's teleconferencing resources also enable representatives from school districts, regional educational centers, and colleges and universities to meet with one another without the cost and inconvenience of having to travel.

Schools wanting to install an EDNET site must pay for some costs, including those associated with room reconfigurations, separate phone lines, and salaries for site facilitators. The state covers all other installation costs because it believes that these costs will be offset by savings from the decline in building and travel costs. Utah Education Network staff install the EDNET equipment, including television monitors, video cameras, microphones, VCRs, and computers. In addition, EDNET technical trainers show teachers and administrators how to operate the system. Faculty trainers from the state education department and EDNET also train teachers on how to use the system effectively to promote learning.

UtahLINK. UtahLINK's World Wide Web home page (www.uen.org/utahlink) and Gopher server (gopher.uen.org) are a gateway to on-demand electronic information and resources for Utah's educators and students. More than 550 of Utah's 730 public schools are currently connected to the UtahLINK network; all schools are scheduled to be connected by the end of the 1997–98 school year. Network sites are installed by a UtahLINK installation team. UtahLINK also operates a help desk to assist UtahLINK users in solving technical problems. In addition, UtahLINK provides free Internet training classes for all employees of the public education system, both online and in person.

Instructional Television and Telecourses. Utah is working to make television an effective educational tool for teachers. Television stations KUED-7 and KULC-9 broadcast nearly 70 instructional television series a year that include about 700 individual programs. Programs are geared to students in kindergarten through grade twelve and are reviewed and selected by Utah educators to meet core curriculum requirements. "The World of Chemistry" and "Shakespeare on Stage" are two examples of the many programs available to teachers for classroom use. According to a recent random sampling, 36 percent of Utah's public school teachers regularly use instructional television in their classrooms.

The two stations also offer general educational development (GED) courses for people seeking a high school equivalency certificate, as well as for-credit telecourses for college and university students. Telecourses are like regular college courses, except that lectures and class assignments are presented over the airwaves, enabling students to view them off campus. The Utah System of Higher Education views telecourses as a way to accommodate the increasing number of college students and meet the need for additional and more convenient course options. Enrollments in for-credit telecourses have climbed steadily, with more than 4,000 students taking these courses each year.

Utah teachers can learn how to integrate instructional television into their teaching methods at professional development conferences offered by the National Teacher Training Institute. In addition, the Utah State Office of Education and the Utah Education Network sponsor an annual Integration Conference to train teachers on the integration of all technologies into the classroom.

Electronic High School

Utah's new Electronic High School, launched in fall 1996, enables the state to provide residents with a full high school education electronically. Courses are offered through various technologies, including television broadcasts, two-way audio-video programs, Internet correspondence courses, long-distance satellite broadcasts, and videotapes.

For fiscal 1997, the state legislature provided funding for a principal to oversee the Electronic High School's operations, including the granting of credit to students who take electronic high school courses. Course grades and credits are entered on a student's permanent

record in exactly the same way as those earned in nonelectronic courses.

The Electronic High School provides educational access to students who are unable to attend school during regular school hours, need to retake a course without interrupting their progress toward high school graduation, want to complete their education in fewer years, or want to take classes not offered by the schools they attend. The Electronic High School also is intended to serve people with disabilities, people returning to the workforce after an absence, people aspiring to better jobs, and students seeking essential workforce skills.

The Electronic High School is especially useful to the large number of Utah students who are being schooled at home. As long as a class provided electronically fits closely into the state's core curriculum, the student can receive credit for it, said Vicky Dahn. Utah will grant credit for a course from another state if that state's core curriculum represents at least an 80 percent match with the Utah core curriculum. "We don't care where the course comes from," said Dahn. "We have kids taking Polish from Wisconsin. We have kids taking all kinds of courses from Alaska . . . . Our attitude is the more the merrier, as long as it's quality stuff."

Remaining Challenges

Having implemented several key pieces of the state's technology plan, policymakers are working to strengthen the effort in several areas. First, according to Utah Education Network Executive Director Stephen Hess, Utah technology leaders are working hard to ensure that technology becomes totally integrated into the instructional process, rather than being treated as an add-on. "We need to get technology into the fabric of our education system," said Hess, adding, "I think that's going to require a lot of patience."

A related issue, said Hess, is the need for teachers to adopt a somewhat different notion of their role in the classroom. To use technology effectively, teachers must relinquish their sense of themselves as the sole purveyors of knowledge and take on the role of guides who help students pursue information and knowledge on their own through technology. Vicky Dahn said that she has seen significant progress in this area in the past few years. "We are seeing teachers do more authentic learning experiences with the students. We are seeing them become less threatened by moving to the side and allowing some of the kids to be the experts on technology while they remain the pedagogical or subject-matter experts."

Hess also believes that Utah needs to provide continued funding for the replacement of outdated equipment. "Funding has to be ongoing, rather than one-time," he said. Hess also indicated that it would be helpful to make technology funding a line item in the state budget, noting that when technology needs are funded through the general budget, they face stiff competition from other priorities such as teacher compensation.

Hess said that there also is a need in Utah for standards concerning the wiring of schools, adequate technology training for educators, and more sharing of technology-based academic content among schools. Finally, the state curriculum needs to include language ensuring that all students will learn to use computers and other information-age equipment, Hess said.

Asked what issue she thinks needs the most attention, Vicky Dahn cited inservice training for Utah's teachers. "When businesses introduce technology or change machines or add a new piece of software, they send employees to get whatever training they need. But our teachers are on board an airplane and it's going at 600 miles per hour and we're asking them to show up for training after work or during the summer vacation. In my opinion, until we do a much more serious job of treating teachers like the professionals that they are, and somehow getting them the training that they need during the regular workday—giving them hands-on help in their schools—until we deal with this inservice issue, we are going to continue to just scratch away at the surface of technology instead of doing any serious restructuring and reforming."

West Virginia: A Commitment to Total Solutions

All of West Virginia's education technology projects reflect an emphasis on the installation of hardware and software, networking, and training. In addition, the state has invested in technology training for teachers and administrators based on "turnkey" or train-the-trainer solutions. Finally, West Virginia is committed to the maintenance and prompt repair of the equipment installed in schools. Community stakeholders played an integral role in developing this model.

Basic Skills/Computer Education Program

With strong gubernatorial support in 1989, the legislature established a ten-year, $70 million program to install computer technology in schools serving kindergarten through grade six. The Basic Skills/Computer Education Program seeks to improve students' reading, writing, math, and computer literacy skills. The office of technology in the West Virginia Department of Education is coordinating the program's implementation. "A broad-based advisory committee of education, business, parental, and community stakeholders developed the program, and local teams are responsible for developing implementation plans at the school and county levels," noted Secretary of Education and the Arts David Ice, who helped draft the legislation.

Since creating the program, the legislature has appropriated about $7 million a year to equip classrooms. Funds, which have come primarily from state lottery proceeds, are allocated to West Virginia's fifty-five counties on a per-pupil basis. Local area networks have been installed in all elementary schools; approximately four computers are in each classroom. Kathy Boone, office of technology project leader for the department of education, explained, "With network servers and student computers, about 20,000 units have been installed statewide." In addition, some school districts have provided local funding to extend the technology acquisition program to the seventh and eighth grades.

Under a state contract, IBM has supplied all hardware for the program. IBM and Jostens Learning Corporation have supplied the software. West Virginia policymakers cite several advantages to this arrangement. Having standardized equipment and software throughout the state has made the training of teachers and staff more efficient. It also has made maintenance and repair efforts easier.

Having a contract with IBM and Jostens is more cost-efficient than having numerous local contracts with various vendors, according to West Virginia Senate Education Committee Chairman Lloyd Jackson, who supports the stakeholders' recommendations. "We've saved substantial amounts of money by aggregating the schools' buying power under one state contract. This also prevents the school districts from reinventing the wheel fifty-five times to participate in a statewide quality program."

Foreseeing that computer technology would change during the life of the program, West Virginia policymakers were careful to build flexibility into the state contract to allow for technology changes. As a result, schools have received 286, 386, 486, and Pentium computers. The contract is for one year, with an option to renew if it is in the best interests of the state and participating schools. "Although the first computers purchased for the program in 1990 are seven years old, they remain useful for learning basic skills in the early grade levels," State Senator Jackson explained.

Training

West Virginia has made it a top priority to provide teachers with the necessary training to use technology effectively in the instructional process. Roughly 30 percent of the funds spent by the state and school districts under the Basic Skills/Computer Education Program are devoted to staff development.

Vicki Allen, an instructional technology coordinator active in the staff development component of the program, reinforces the need for initial and ongoing training for teachers, administrators, and parents. Allen explained, "It is extremely important for teachers to receive training shortly after the school equipment is installed for a turnkey solution. Then

teachers can begin to concentrate on the integration of the technology into the curriculum to improve student achievement." As a result, more than 14,000 teachers have received in-depth, hands-on staff development for successful implementation in their classrooms.

Although the state contract includes comprehensive training, the West Virginia Center for Professional Development may provide summer awareness sessions on global technology concepts and other education issues to give teachers and administrators a "big picture" of education in West Virginia. The center's sessions for principals encourage them to support the teachers as transformation and learning take place in the classroom because of the integration of technology into the curriculum.

Implementation Model

Because the Basic Skills/Computer Education Program has been such a successful model, the following technology programs have been implemented in the same way with statewide stakeholder input and recommendations. The model includes all the components for a turnkey solution and a major emphasis on staff development and curriculum integration.

State Technology Plan. The *West Virginia State Technology Plan* was completed in October 1995, as part of the Education First activities of a forty-five-member technology task force. To comprehensively address instructional technology, the plan weaves together the focused technology projects and corporate partnerships.

Internet Connections. Bell Atlantic-West Virginia and the West Virginia Department of Education have a partnership to connect schools in areas that Bell Atlantic-West Virginia serves. The program is known as the Bell Atlantic WORLD SCHOOL Program. Citizens Telecom, Hardy Telephone, Armstrong Telephone, and Spruce Telephone plan to offer a similar program to schools in their service territories.

Fifty pilot schools were connected during summer and fall 1994. After the pilot schools were connected, other schools were invited to join the project through a self-nomination process that confirmed a turnkey solution. Now 677 schools in the Bell Atlantic-West Virginia service territory have Internet access. Two teachers from each self-nominated school are trained on the use and curriculum integration of the Internet. More than 19,500 electronic mail (e-mail) accounts have been issued for the education department's e-mail server located in Morgantown at the West Virginia Network for Educational Telecomputing (WVNET).

Almost 80 percent of the state's public schools have Internet connections. By the end of 1997, approximately 98 percent of the schools will be connected. The process for the WORLD SCHOOL Program implementation has received the Smithsonian Computerworld Award and has become part of the Smithsonian permanent collection.

Telecommunications/Technology Grant Program. The state legislature appropriated $1.2 million in fiscal 1996 and fiscal 1997 to provide schools with multimedia computers that can access the Internet and other communications systems. The computers were installed in high schools first, and then in junior high, middle, and elementary schools, as funds allowed. The computers will be used to incorporate multimedia software and CD-ROM packages into the classroom. The units will be used to access the Internet either through the WORLD SCHOOL Program or other connections. Additional money was appropriated to provide staff development training on Internet use.

InfoMine. The West Virginia Library Commission received a $2.1 million federal grant to place InfoMine workstations in public libraries and fifty-five public schools to facilitate access to the Internet and academic databases and library collections. A workstation has been installed in one high school in every district as the turnkey model for others to follow.

Technology Demonstration Sites. The state legislature has provided funds for multimedia and innovative uses of technology to improve teacher productivity and student

use. Fifty-one demonstration sites have been established at schools throughout the state to help teachers understand how to use multimedia in the classroom. Applications include advanced multimedia and a virtual reality lab. These sites help other teachers and schools understand how to integrate technology into the curriculum. As the statewide programs are implemented to address basic needs for technology knowledge, other replicable programs, which may not always be needed statewide, are possible through the demonstration sites.

Curriculum Technology Resource Center. The Curriculum Technology Resource Center (CTRC) is a program in which the teachers decide each year on the focus of the technology. From 1993 through 1996, CTRC provided comprehensive training on the integration of videodiscs across curricular areas. The teachers received necessary and appropriate videodiscs, staff development, and equipment for their schools. In 1995 and 1996, the training also included multimedia applications and various CD-ROM software packages; schools received multimedia computers with Internet capability as part of the training. In 1997 teacher and student teams will receive training on the use of the Internet. After completing the training, these teams will receive laptop computers and projection devices for classroom use.

Distance Learning. Students, teachers, administrators, parents, and community members have participated in distance learning courses, teleconferences, and/or telemeetings through 318 satellite downlink sites in West Virginia.

Microsoft Partnership. Microsoft has distributed more than $2 million worth of multimedia software to more than 340 elementary and secondary schools during the past four years. The software includes multimedia reference tools and creative writing and art programs. Full-day staff development workshops are offered regionally for teachers at the selected sites.

West Virginia Department of Education/IBM Reinventing Education Grant. The department received a three- to five-year, $2 million grant from IBM. The focus of the grant is to improve academic and workplace skills through use of the Internet.

K–Adult Instructional Technology Objectives. Department instructional staff have developed the technology objectives to be mastered by students and integrated into curricular areas. The West Virginia Board of Education adopted these objectives in December 1996. In addition, the state board will adopt a uniform statewide assessment program to measure student performance by grade level in various subjects.

West Virginia Tech Corps State Charter. Through the leadership of the West Virginia Department of Education, the Educational Broadcasting Authority, the West Virginia Education Fund, and Bell Atlantic-West Virginia, the West Virginia Tech Corps has been chartered in West Virginia. The mission of the corps is to coordinate volunteers to help schools implement technology and help communities become more involved in school activities. West Virginia Tech Corps is coordinating West Virginia Net Days, which enable schools to install network cabling economically with the help of volunteers who have expertise in technology.

School Technology Teams. As part of the Educate America Act, West Virginia's Education First Initiative provides for school technology teams. These teams, composed of teachers, administrators, students, and community business partners, are responsible for technology planning and implementation for each school.

In addition to these statewide initiatives, many counties and secondary schools have begun local technology initiatives in schools.

Maintenance

West Virginia has worked hard to ensure that all computers installed in schools remain in good repair. State Senator Jackson stressed the importance of West Virginia's technology maintenance program, saying, "If you plan your lessons around computers and they don't work one day, and they don't work the next

day, pretty soon you will just quit integrating the technology [into your classes]."

To make effective maintenance easy, West Virginia has just one computer supplier, IBM, for all school districts, Jackson said. Maintenance and repair staff of the state's regional education systems, which are responsible for repairs, are familiar with the machines and can usually fix problems quickly. The state requires that repairs of critical equipment, such as central processing units, be completed within twenty-four hours. It also has urged the regional education systems to complete repairs on site, whenever possible. "We've really pushed the regional education systems hard, and we ask them to submit a quarterly report. Maintenance is just critical to people's acceptance of these programs," said Jackson.

Equity

In an initiative unique among the states studied for this report, in December 1996 the West Virginia Board of Education adopted a policy requiring schools to open their doors before and after the regular school day to increase community access to technology. The policy states that "county boards, in cooperation with schools, shall, to the extent practicable and as funds and other resources are available, provide students (including those enrolled in adult basic education), teachers, parents, and citizens access to technology, especially computers, in the public schools during nonschool hours."

Political Support

According to Jackson, the West Virginia education technology program exists because of former Governor Gaston Caperton. "He has to get a wide share of the credit. It was clearly his idea and vision that caused this to happen." Jackson also credits the state legislature, whose leaders "understood the wisdom of trying to use technology to move West Virginia ahead in education." He said that legislators saw technology's potential to be a "a great equalizer" in a state where students from rural areas often have lagged behind students from urban and suburban areas in educational achievement. Jackson noted that teachers also have become important proponents of the technology program. "Once they become trained and understand the value of the program, they become real assets in selling the program, especially in this day of competing resources."

Transition and Next Steps

Although West Virginia's use of education technology progressed tremendously under Governor Caperton's leadership and with the support of the legislature and the West Virginia Board of Education, education technology continues to be a high priority of Governor Cecil Underwood. Governor Underwood supports education technology, understands the importance of its uses, and recognizes that student and citizen knowledge of technology will affect the economic development of West Virginia.

Governor Underwood supported legislation to create a chief technology officer who will report directly to the Governor on all state agency technology issues. The Governor's office also is focusing on upgrading the statewide backbone for telecommunications for all state agencies and is exploring the use of interactive distance learning sites.

One of Governor Underwood's first actions was to applaud Governor Caperton's projects and publicly announce a next-step program for middle and high schools, Student Utilization of Computers in Curriculum for the Enhancement of Scholastic Skills (SUCCESS). SUCCESS was established under the Jobs Through Education Act (Senate Bill 300), which calls for the creation of a technology infrastructure for middle schools and high schools to help students attain skills in word processing, graphic presentation, spreadsheets, databases, Internet use, and telecommunications. The SUCCESS program also emphasizes the importance of developing critical-thinking and decision-making skills; understanding the modern workplace environment; making informed career decisions; gaining access to labor markets and job placement services; and obtaining information on college and other

postsecondary education opportunities. State Senator Jackson said, "Implementing the middle and high school phase will be more complicated than the elementary school phase because the technology needs of the state's middle schools and high schools vary greatly. In the kindergarten through grade six plan, we assumed, correctly, that none of the schools had previous technology programs that we had to worry about stepping on. It's much more diverse in the middle schools and high schools." Consequently, the first step for state planners will be to conduct a survey of technology resources and needs in grades seven through twelve.

Although the computer systems that will be provided for grades seven through twelve probably will not be as thoroughly standardized as those installed in kindergarten through grade six, Jackson said, "Some standardization will be built into the program to ensure that repairs can be done easily." He also noted that staff development for grades seven through twelve will pose special challenges. "The kindergarten through grade six program was homogenous, so staff development was a whole lot easier. It will be much more difficult with grades seven through twelve to provide the kind of staff development that will really get people to start using these machines in much more inventive and ingenious ways. It will be a totally different kind of training."

The program for middle schools and high schools was also planned with extensive involvement from teachers, principals, school superintendents, technology experts, regional education system representatives, and members of the business community. "It is a big group that met often. The meetings were very well attended," said Jackson. "I think we have a process that will build the consensus we need."

Ongoing Concerns

West Virginia officials' top concern is to continue improving existing programs to train teachers and maintain equipment. In addition, officials said that securing funds for education technology efforts will be an ongoing challenge. Jackson noted that this will be especially true because of new pressures that federal welfare reform is putting on the state budget. "As issues such as welfare reform, job training, and child care get shoved to the state level, I can already see demands on money we might otherwise use for technology," he said.

Conclusion

The initiatives in Arkansas, Florida, Iowa, North Carolina, Utah, and West Virginia illustrate a variety of approaches to incorporate technology into teaching and learning. They also reflect these states' commitment to ensuring that their students are prepared to meet the employment challenges of the twenty-first century. All of the states are seeking to improve professional development opportunities for teachers on the use of technology in the classroom. Moreover, Governors, legislatures, and boards of education are continuing to explore innovative ways of funding education technology to ensure that all students have access to high-quality equipment and instruction. Finally, these states are examining how the effectiveness of education technology can be measured to ensure that investments produce the desired results. Although the six states have taken slightly different approaches to providing technology in the classroom, key elements are present in each state's initiatives.

A technology plan that outlines the vision for providing education technology is essential to address issues such as professional development, funding, and curriculum integration. It is critical that legislators, parents, school personnel, employers, and students participate in the initial development and ongoing review of the plan to ensure that it meets the needs of these various constituencies.

Professional development must be an integral part of state plans and must be ongoing. Teachers must be given time and opportunities to learn how to incorporate technology into instruction. Teachers also need time to keep abreast of the latest technology applications to maximize student achievement. There is an urgent need for professional development programs directed toward helping teachers adjust to the new challenges presented by technology. If technology programs currently being implemented at the state and local levels are to succeed, teachers must be provided with high-quality training that gives them the confidence and skills to use technology effectively.

To gain support for the ongoing funding that is needed, legislators must be educated on what is required to establish and sustain a successful technology program. Consultation and inclusion of legislators early in the development of the technology plan will help secure their commitment.

The integration of technology into the curriculum is a relatively new area and one that requires more research. States should consider funding pilot projects and/or demonstrations to explore strategies for making the best use of technology to advance state education goals.

The six case studies offer promising ideas to address the key issues related to the use of technology in classrooms. They also provide insight into the challenges that states face as they try to make technology an integral part of the learning process and use it to raise student achievement.

Governors can help increase awareness of the need for ongoing support for education technology by highlighting its importance and articulating a vision for its potential. They can also help create a positive climate for education technology within state decisionmaking bodies.

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Online Resources

Arkansas Public School Computer Network—http://www.k12.ar.us

Florida Department of Education—http://www.firn.edu/doe

Florida Distance Learning Network—http://www.gc.cc.fl.us/fdln

Iowa Department of Education—http://www.state.ia.us/educate

Iowa Public Television—http://www.iptv.org (For information about the Iowa Communications Network, click on "Iowa Database.")

North Carolina Department of Public Instruction—http://www.dpi.state.nc.us

Utah Education Network—http://www.uen.org

Utah State Office of Education—http://www.usoe.k12.ut.us

West Virginia K–12 Home Page—http://access.k12.wv.us